
**Final Report of the
Sustainable Use,
Ecological
Footprint and
Ecosystem
Services Focus
Group**

**Submitted to Awareness,
Mainstreaming and
Sustainability Working
Group of the Biodiversity
Strategy and Action Plan
(BSAP)**

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Synopsis

This integral report is a collective effort of three groups of experts, each of them is tasked to review Hong Kong's existing status and explore the way forward in their respective topic areas.

This report starts by a section dedicated to analyzing the Ecological Footprint of Hong Kong, which is a holistic quantitative measure to track the overall demand on natural resources in Hong Kong over the past few decades. It provides high-level information on the trend we are seeing in Hong Kong, yet it provides useful analysis to highlight and prioritize areas that are contributing to Hong Kong's Ecological Footprint. It finds that, while our city has been enjoying a high level of human development over the past few decades, our success has been built at the cost of a great deal of natural resources. If everyone in the world lived the lifestyle we lead in Hong Kong, humanity would need 2.6 Earths to sustain our resource needs. The city's operational and developmental model falls outside the boundary of "One Planet Living", which makes Hong Kong one of the cities that adopt an unsustainable style of consumption and living.

Based on the analysis, it is recommended that the Hong Kong Government takes lead in measuring our Ecological Footprint and start to make the community become aware of the impacts of our "over-consumption" lifestyle, and the consequences of Ecological Footprint overshoot. Forging ahead, the Government should make use of this holistic measure as one of the guiding principles when establishing the city's strategic and sustainable development plan, and formulate a time-frame and roadmap to help Hong Kong reduce its Ecological Footprint. A list of actions that have been undertaken by other countries and cities to address, contain and reduce their Ecological Footprint has been compiled and attached to this section, which can demonstrate what can be done in this arena under the global context.

Hong Kong does not have a lot of natural resources, which makes us depend very much on import of materials to support our needs for them whether it is for infrastructure or individual use in our daily lives. In this connection, what we use in Hong Kong very much affects the biodiversity and habitats around the world, which also means our Ecological Footprint (and use of biodiversity) outside Hong Kong is in fact much larger than what is within the city. With this in mind, the second part of this report looks into an array of commodities imported into and utilized in Hong Kong in-depth. These commodities, which bring major impacts on environment and biodiversity during their production, are reviewed and prioritized according to their relevance and significance with regards to Hong Kong. The key commodities identified in the process include seafood from the wild and from farm (encompassing seafood in general, live reef food fish, sharks, manta and devil rays), timber, paper, traditional Chinese medicine from the wild and beef.

Based on the analysis, commodity-specific recommendations are provided in details in the appendix in this section. Multi-faceted approach is often needed for each of

these commodities. These approaches include filling research gap, improve trade data collection, create access to relevant information, strengthen CITES system in Hong Kong, promote sustainable production and use of these commodities, bridging public awareness and action, and improved regulation in trade in these commodities. Addressing the issues discussed and implementing the recommended strategy in this section would ensure a long-term sustainable use of these natural resources and contribute to reducing the Ecological Footprint of Hong Kong.

The third section of this report examines the ecosystem services provided by different habitats in Hong Kong. Our heavy reliance on imports to fulfill the need for natural resources come from Hong Kong's high Ecological Footprint and the fact that our natural resources, also termed as biocapacity, available within Hong Kong is limited. If Hong Kong is to sustain by its own resources within the territory, we would need 150 Hong Kong! While it is not practical for Hong Kong to become self-sufficient, we have to understand and monitor the ecosystem services provided by various habitats and the biodiversity so reside in such habitats. Although we can import some of the services provided by the ecosystem such as provisioning service (e.g. food, water, raw materials), we do depend a lot on our local ecosystem to provide regulating (e.g. erosion prevention), cultural and amenity (e.g. aesthetic, recreation) services in the Hong Kong perspective.

All available ecosystem services (e.g. seafood from the sea, forest to absorb CO₂) and habitats available in Hong Kong are reviewed and qualitative descriptions of each of them are compiled in appendices in this section of the report. In addition, a quick review was conducted to look into the various kinds of ecosystem services provided by each of these habitats in Hong Kong, and the significance of these services to Hong Kong is scored based on available information. The quick research reveals a paucity of study regarding ecosystem services in Hong Kong, which makes it extremely challenging, if possible at all, to even attempt to quantify these services. It is recommended that an in-depth ecosystem assessment for Hong Kong be conducted, and its links to human well-being. This would form the foundation on which valuation on ecosystem services by different approaches could be conducted, and ultimately a suite of tools could be developed to integrate ecosystem services information into decision making – a set of tools to help conserve Hong Kong biocapacity.

Final Report of the Sustainable Use, Ecological Footprint and Ecosystem Services
Focus Group Submitted to Awareness, Mainstreaming and Sustainability Working
Group of the Biodiversity Strategy and Action Plan (BSAP) Section I – Ecological
Footprint

Title

Measuring Ecological Footprint of Hong Kong

Relevant Aichi Biodiversity Targets

Ecosystem Services: T4, T6 and T7

Group leader

C.W. Cheung

Key experts / stakeholders who were involved in the discussion

- a) Within the Steering Committee/ Working Groups
Mr. C.W. Cheung
- b) Outside the Steering Committee/ Working Groups
Dr. Allen To (report coordinator)

Objective

- a) To measure the use of natural resources in Hong Kong through calculation of its Ecological Footprint

Scope

Ecological Footprint: Aichi Targets T6, T6 and T7

To quantify Hong Kong's use of natural resources through Ecological Footprint, and propose recommendations

Methodology

- a) Desktop research – gathering different case studies in different countries on how they take into account Ecological Footprint to achieve sustainable development
- b) Existing working done by WWF and Global Footprint Network – the Hong Kong Ecological Footprint Report 2013, published in late 2013 measures Hong Kong's Ecological Footprint

Hong Kong's existing status

Ecological Footprint

The Ecological Footprint is an accounting tool used to measure the land and water areas mankind uses to provide all that we take from nature. The Ecological Footprint is determined by adding up all land and sea areas needed to provide the natural resources we consume. These surfaces, also known as biocapacity, produce goods such as crops, livestock, seafood, timber and paper; they are also used to build our infrastructure or used to absorb CO₂. The Ecological Footprint is measured in global hectares (gha). The calculations reported here are based on 2008 data, which are also used in the latest Ecological Footprint report published by WWF-Hong Kong.

Global context

Since the 1970s, humanity has been in ecological overshoot, meaning that the annual demand we place on the world's ecosystems (Ecological Footprint) exceeds what the Earth is able to provide (Biocapacity). Prior to that, individual cities and countries ran biocapacity deficits; but now, humanity's aggregate demand exceeds what the Earth can renew.

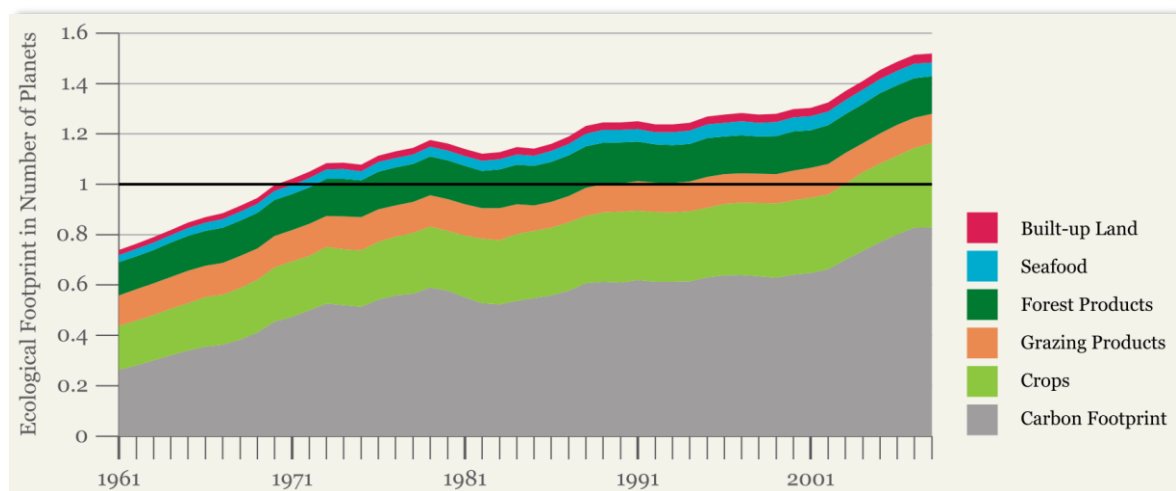


Figure 1. Human's Ecological Footprint globally (WWF-Hong Kong 2013).

In 2008, humanity consumed ecological resources and services 1.5 times faster than Earth could renew them — a 100 per cent jump from 1961, when people used approximately three-quarters of the planet's biocapacity. If trends follow even the moderate projections of UN agencies, by the middle of this century, humanity will require the resources of almost three Earths.

The Earth cannot sustain such levels of overshoot. Overshoot is possible for a limited time, but at the cost of depletion and degradation of resources. Weaker natural capital stocks erode economic opportunities and increase social pressures, as a number of lower-income countries are already experiencing. Egypt, El Salvador and Pakistan are all facing severe economic burdens imposed by their biocapacity deficits.

Today, several signs of overshoot can be seen around the globe: carbon accumulation in the atmosphere, depleted fisheries, deforestation and soaring food costs. These signs will become more frequent in the near future: costs of everyday inputs such as food and water will increase, while the value of economic assets that depend on cheap resource inputs (such as airplanes and airports, hotels in distant locations, aluminium smelters, or artificially-heated spas) will decline as they become over-proportionally more expensive to operate.

Hong Kong

From 1962 to 2008, Hong Kong's per capita Ecological Footprint increased almost four-fold. The average Hong Kong resident now has an Ecological Footprint of 4.7 gha. Compared this with about 150 countries with populations over 1 million, only 25 countries have a larger per capita Ecological Footprint than that of Hong Kong. If everyone in the world lived the lifestyle we lead in Hong Kong, humanity would need 2.6 Earths to sustain our resource needs.

If Hong Kong's Ecological Footprint (4.7 gha) is balanced against the fact that Hong Kong's available biocapacity is only 0.03 gha per person – a 150-fold deficit. Hong Kong's biocapacity deficit is significant. Only eight countries have a bigger per capita biocapacity deficit (Qatar, Kuwait and the UAE run the largest per capita deficits). And in Asia, Hong Kong has one of the largest biocapacity deficit, second only to Singapore. This means that, per person, Hong Kong is more dependent on external biocapacity than most of the world's economies.

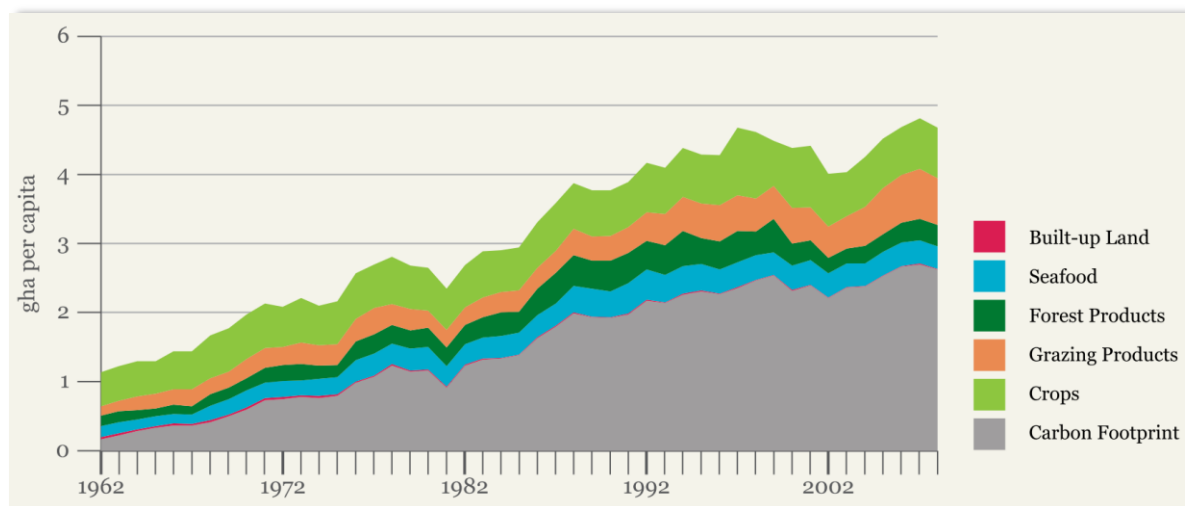


Figure 2. Hong Kong's Ecological Footprint over the past few decades (WWF-Hong Kong 2013).

The widening gap between demand (Ecological Footprint) and supply (biocapacity) makes Hong Kong's economy highly dependent on both the availability of ecological assets outside its borders and its ability to pay for access to the resources and services these resources produce. For example, Hong Kong imports seafood from more than 170 countries and territories around the world — at a time when many fisheries are in decline.

Determining the overall demand placed on nature by particular human activities requires an additional analytical step beyond basic Ecological Footprint accounting. Since statistical offices track how households, governments and industries spend their money, these statistics can be used to translate land-based Ecological Footprint results into activity-based Ecological Footprint results.

The figure below shows Hong Kong's Ecological Footprint divided into three specific final demands. Household consumption represents consumables purchased by households. This direct consumption by households accounts for 78 per cent of Hong Kong's Ecological Footprint. This indicates that the daily consumption decisions made by families and individuals (at home and at work) significantly impact Hong Kong's Ecological Footprint trends.

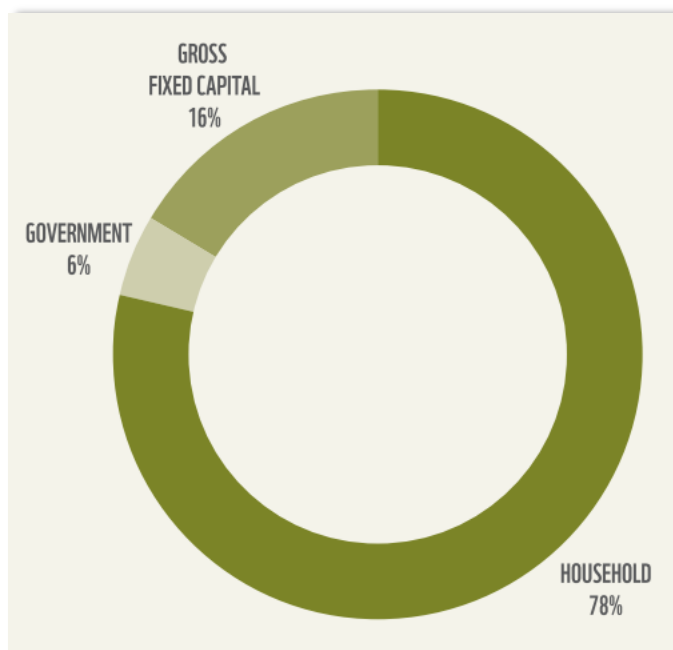


Figure 3. Percentage of Hong Kong's Ecological Footprint coming from household (families and offices), government (government service) and gross fixed capital (long-lasting goods such as infrastructure) (WWF-Hong Kong 2013).

The remaining Ecological Footprint includes consumable items paid for by the government, such as school supplies in public schools, police equipment, paper for public administration and so on (6 per cent of the total); and investments in lasting assets, such as the construction of buildings, roads, factories and equipment (16 per cent of the total).

While this direct consumption by the government seems small, decisions made by governments have a large impact on how we build cities and infrastructure, which in turn strongly influences household consumption patterns.

By further looking at detailed consumption categories (based on the United Nations' Classification of Individual Consumption According to Purpose) as shown in the figure below, individual "hotspots" within Hong Kong's Ecological Footprint can be identified. This figure displays the top 24 of 42 consumption categories, ranked by Ecological Footprint size (the remaining 18 categories were aggregated into the "Other" category). This breakdown clearly illustrates the connection between daily activities and the Ecological Footprint.

The main contributor to Hong Kong's household-related Footprint comes from the "Food" category (23 per cent), followed by "Electricity, gas and other fuels" (14 per cent), "Transport services" (12 per cent) and "Clothing" (12 per cent). These top four categories account for 61 per cent of the household component of Hong Kong's Ecological Footprint.

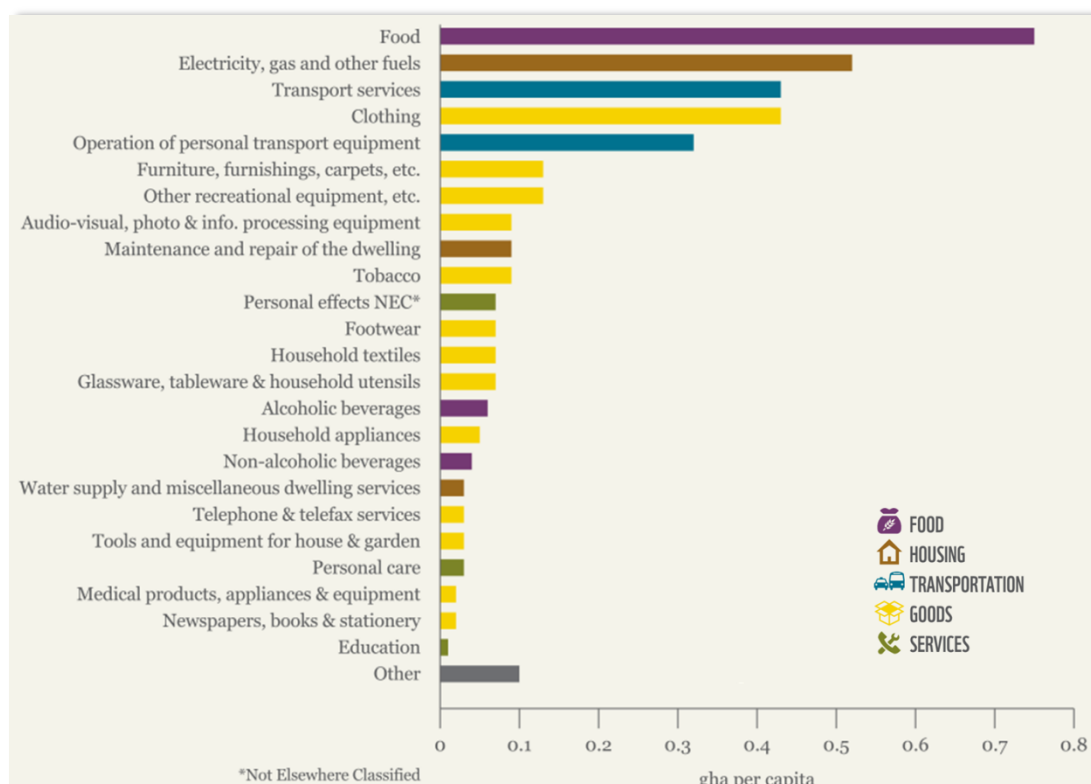


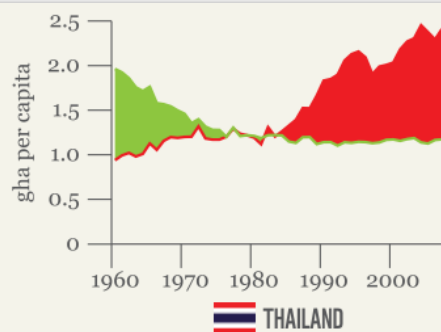
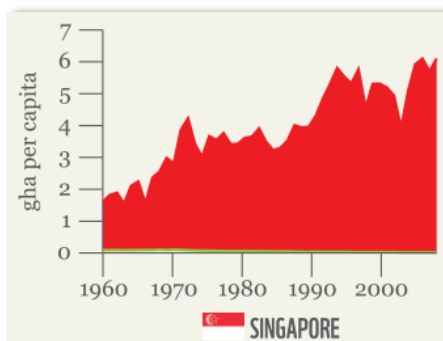
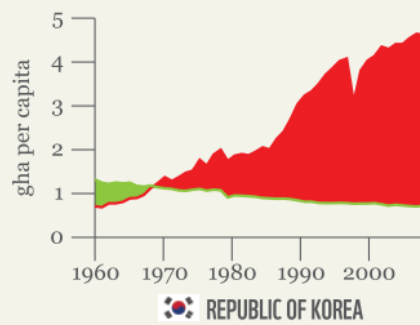
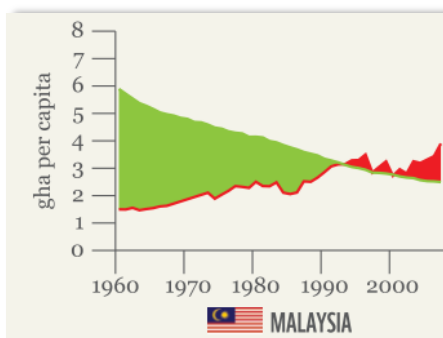
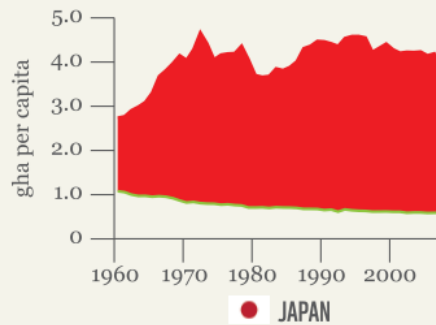
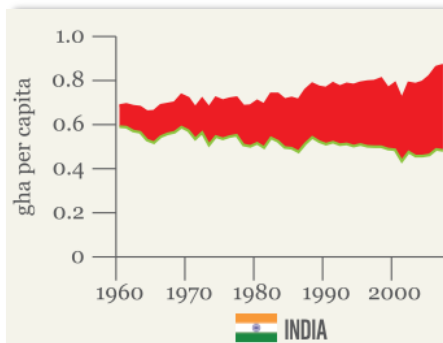
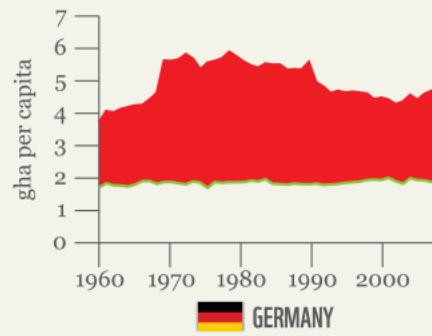
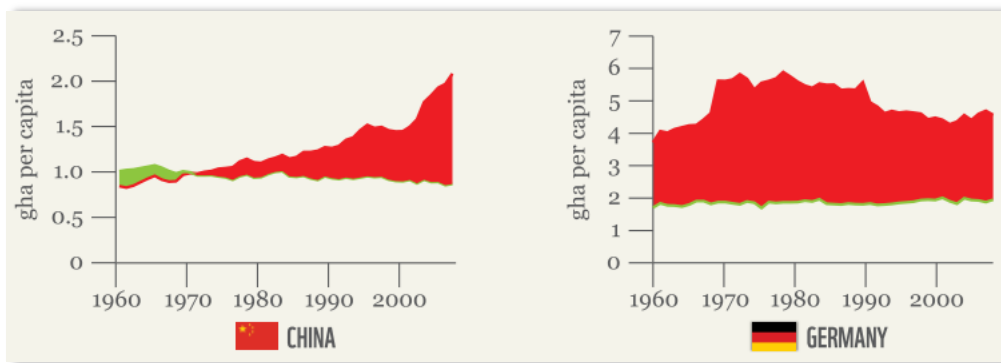
Figure 4. Breakdown of the per capita household Ecological Footprint of Hong Kong, in 2008 (WWF-Hong Kong 2013).

Resource status of Hong Kong's most important trading partners

Hong Kong gains access to essentially all its ecological resources through trade, with virtually none coming from its own ecosystems. Reliance on foreign ecological assets, notably to provide food and other essential commodities, has increased nearly 400 per cent over the last three decades.

However, as these charts show, the biocapacity deficits of Hong Kong's major trading partners have steadily increased over the past 50 years, as their own biocapacity has diminished and their Ecological Footprints have increased.

As resources become scarcer and competition for those that remain heats up, Hong Kong will become increasingly exposed to world market price volatility and supply disruption. Hong Kong must now recognize the risks its trading partners' resource constraints pose to its own economic prosperity.



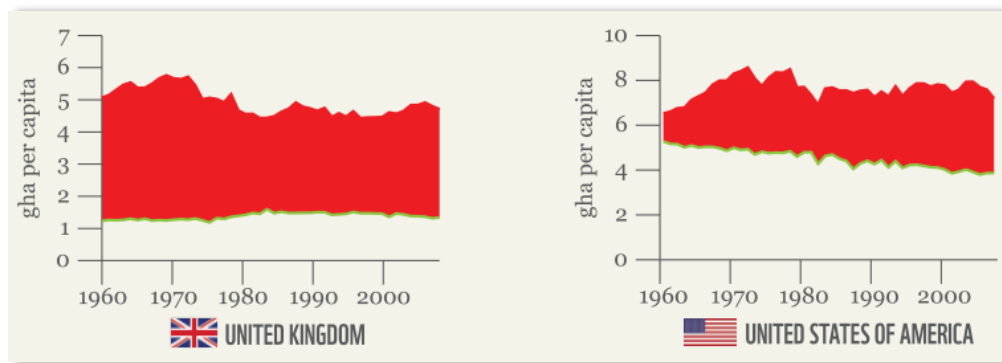


Figure 5. Hong Kong's major trading partners. The Ecological Footprint (red line) and biocapacity (green line) are expressed in global hectares per person. Biocapacity deficits are shaded red, reserves are shaded green (WWF-Hong Kong 2013).

How sustainable Hong Kong's development has been?

At every UN conference it is expressed that sustainable development is humanity's shared dream. "Development" can be seen as the commitment to well-being for all the people of the world, while "sustainable" refers to the budget: in order for change to be lasting, development has to occur within our planet's ecological constraints.

Without a way to physically measure sustainable development, the debate about realizing this dream will remain abstract and hard to implement. Conversely, measuring sustainable development clarifies the debate and encourages nations and cities to take their fates into their own hands.

One way of measuring "development" is through the United Nations Development Programme's (UNDP) Human Development Index (HDI). This indicator reflects a country's achievements in terms of its citizens' longevity, education and income.

The traditional path to improving development has been resource-intensive: higher development achievements have involved increased resource use.

However, access to growing levels of ecological resources is no longer guaranteed in today's world and this reality may threaten long-term improvements in human welfare. Countries that pursue the path of sustainable development will be best positioned to meet their future needs.

One way to assess a country's progress toward sustainability — defined as achieving a high degree of well-being for its people within the means of its ecosystems — is by mapping the two dimensions of sustainable development (Human Development and Ecological Footprint) on the same graph. The per capita Ecological Footprint is plotted on one axis, while the UNDP's Human Development Index is plotted on the other, as shown below:

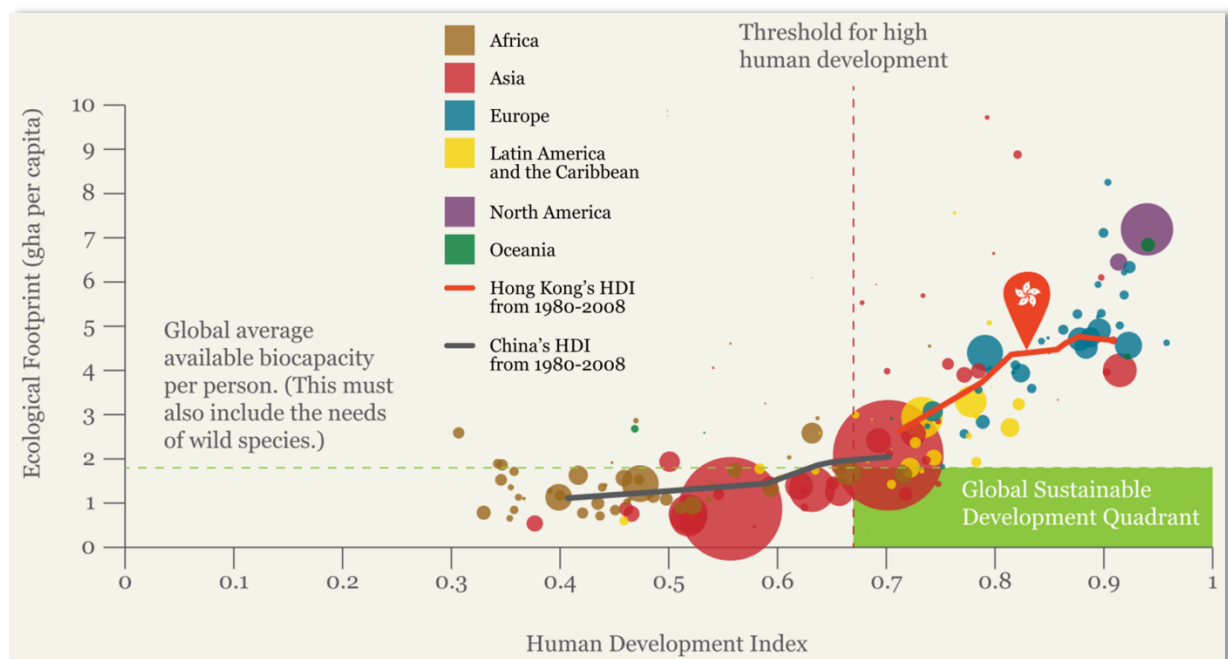


Figure 6. The UNDP's Human Development Index versus per capita Ecological Footprint. A low per capita Ecological Footprint and a high HDI score are the necessary conditions for sustainable development (indicated by the green rectangle in the bottom-right quadrant). The size of each dots represent the relative human population of different countries / territories (WWF-Hong Kong 2013).

The resulting graph compares nations' quality of life, including Hong Kong and China, with the amount of global biocapacity available, illustrating the challenge of creating a high level of human well-being without depleting the planet's or a region's ecological resource base. The graph appears in the UNDP Human Development Report 2013, which concludes:

"To sustain progress in human development, far more attention needs to be paid to the impact human beings are having on the environment. The goal is high human development and a low Ecological Footprint per capita (the lower right quadrant). Only a few countries come close to creating such a globally reproducible high level of human development without exerting unsustainable pressure on the planet's ecological resources."

As can be seen, in the period between 1980 and 2008 Hong Kong made significant gains in human development; moving from a high level (HDI=0.71) to a very high level (HDI=0.91). Yet these gains were realized at the cost of a great deal of resources (the increasing per capita Ecological Footprint). China, on the other hand, started at a relatively small per capital Ecological Footprint; however the recent boom in development throughout China has also led to a gradual increase in its Footprint and its per capita Ecological Footprint has already passed the global average biocapacity per person. This trend does not bode well for the sustainability of the planet's natural resources and human development in the long run.

Recommended strategy

Short-term

Calculate and Announce

WWF has been working with scientific partners, using globally available data, to calculate the Ecological Footprint of individual countries in the world, including that for Hong Kong. Such estimation has been proven essential as a measurement to quantify the level of use of natural resources and a powerful tool to communicate with stakeholders on this issue and the concept. Given the importance of communicating this issue and concept widely in Hong Kong as discussed below, it is relevant therefore for Hong Kong to regularly calculate the city Ecological Footprint, so that Hong Kong is always informed of our latest status.

A number of governments, such as governments of Costa Rica, Wales, Switzerland, Spain and France have taken their lead to initiate measurement and announcement of their own Ecological Footprint (also see Appendix I).

It is recommended that the Government should regularly measure and announce Hong Kong's Ecological Footprint.

Awareness building

Existing research clearly indicates that globally humanity is over-consuming natural resources, and Hong Kong has one of the relatively high per capita Ecological Footprint in the world, 26th globally. The research shows that daily consumption, including that by individual, business and government plays the critical role in shaping Hong Kong's Ecological Footprint – it accounts for 78% of Hong Kong's Ecological Footprint. Four major “hotspots” of daily consumption has been identified, namely, “food”, “electricity, gas and other fuels”, “transport services”, and “clothing”.

Effort has been put in place by different sectors in Hong Kong to raise the awareness of and drive actions towards reducing our demand for natural resources. To name a few, various NGOs in Hong Kong has organized initiatives to recycle and reuse clothing and textiles, reduce meat consumption, sourcing sustainable seafood, reducing and recycling food waste, promoting use of sustainable wood products, reduce use of energy by electrical appliance at home, low-carbon operating office, recycling of various appliances and furniture at home; which all target to change individual lifestyle and improve sustainability in the daily operation of business sector. The Government has also initiated or facilitated series of awareness building campaign such as food waste reduction, material recycling and providing funding to support green initiatives, to name just a few. The Zero-Carbon Building also serves as an excellent “living teaching room” to share innovative design, technologies in eco-building and low-carbon lifestyle with industry and the general public.

Ecological Footprint is constructed in a way to be a holistic measurement to quantify and track our demand on natural resources hence the potential impact of our daily

life and business operation on the environment. Importantly, Hong Kong's heavy reliance on importing our natural resources means that Ecological Footprint, which tracks use of resources whether it is sourced within or outside Hong Kong, would be a very relevant tool for our city. The Ecological Footprint in a way informs government, business and the public on how well we've been doing through all these various initiatives. It therefore can serve as an excellent communication tool to disseminate the idea of all these different initiatives in Hong Kong – all of them point to the fact that Hong Kong is over-consuming natural resources and all these initiatives are helping us to reduce our Ecological Footprint.

Changing daily behavior can be a relatively long-term process and it means that it has to be started at very early stage. Education and public awareness raising on the issues of Hong Kong's over-consuming natural resources and the general concept of Ecological Footprint is critical. This can help business and public in Hong Kong to understand what the "big picture" for Hong Kong is and how these seemingly separate and independent initiatives all add up to reduce our Ecological Footprint. Also it is worthwhile to use the guiding principles of One Planet Living¹ to link to Ecological Footprint. All these would be fundamental to facilitate the gradual shift to low Ecological Footprint model in Hong Kong in the long run.

It is recommended that, after the measurement of Hong Kong's Ecological Footprint, the Government should work with relevant stakeholders in Hong Kong to spread the "over-consuming" issue and "Ecological Footprint" concept, raising the awareness on these in Hong Kong.

Long-term

Adopt and Manage

The Global Footprint Network, the scientific partner of WWF in producing Ecological Footprint Report, has a five-phase framework to help individual city and country to initiate large-scale shifts in thinking and policy – start from awareness, and then move from adoption to action. The framework is to help individual city and country to weigh different options to shift trend of Ecological Footprint in the direction of sustainability, for example, through making major changes in policy and investment.

From the latest available information, more than 57 nations have engaged at different levels among the five-phases. A number of countries such as Japan, Switzerland, UAE, Ecuador, Finland, Scotland and Wales have formally and nationally adopted Ecological Footprint in their governmental planning (Phase III).

¹ One Planet Living is a global initiative based on 10 principles of sustainability developed by BioRegional and WWF. These principles include zero carbon, zero waste, sustainable transport, local and sustainable materials, local and sustainable food, sustainable water, land use and wildlife, culture and community, equity and local economy, and health and happiness.

<http://www.oneplanetliving.org/index.html>

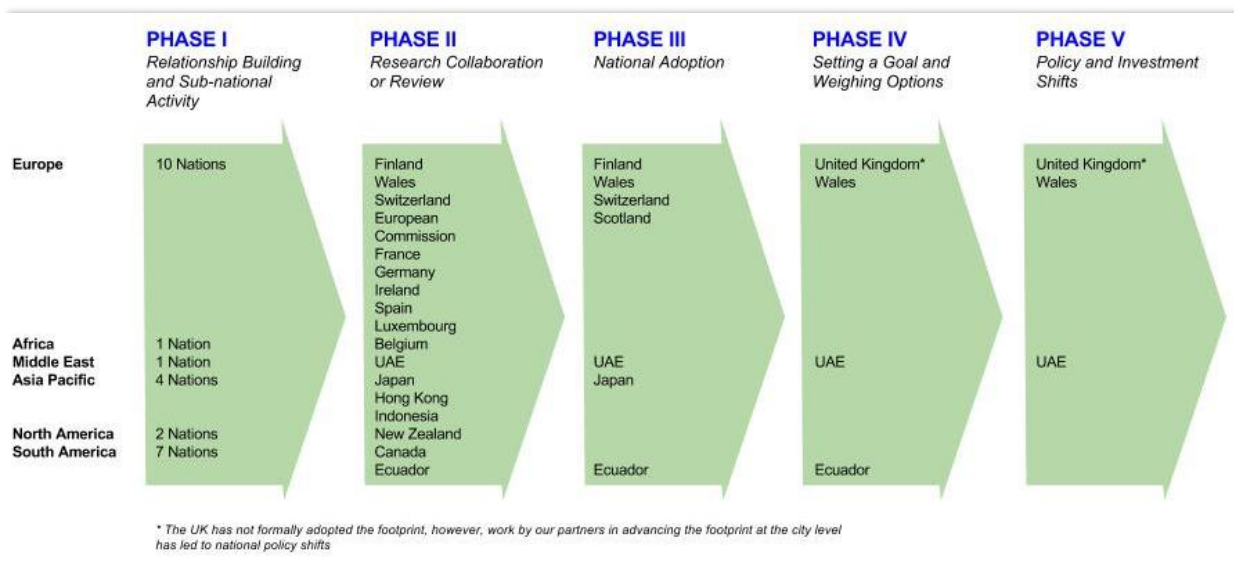


Figure 7. The five-phase framework (Global Footprint Network 2011).

Ecuador, among others, has taken this further. Ecuador has been using Ecological Footprint as a resource accounting tool. In addition, not only does Ecuador announced the ambitious initiative to preserve one million acres of the Amazon rainforest by keeping the country's largest undeveloped oil reserve permanently in the ground (an action to conserve its own biocapacity), Ecuador has also set national target to reduce its overall Ecological Footprint (Phase IV). These make Ecuador one of the few leading nations in the world to achieve Phase IV.

UAE was reported to have the largest Ecological Footprint per person in the world in 2007. Since then, the government has been proactive and within just three years UAE has progressed through all five phases and attained Phase V. One of the recent Phase V work by UAE includes the construction of scenario tool to transform first their electricity sector followed by other sectors of the economy, to reduce the Ecological Footprint. Another Phase V work by UAE is the development of the Madsar City², located in Abu Dhabi, which is reported to be the world's most sustainable city.

Wales pledged a national goal to reduce its per capita Ecological Footprint to the global average biocapacity available – its "One Wales: One Planet" vision in the national Sustainable Development Scheme launched in 2009. Since then, the Welsh Government has launched programmes to reduce the Ecological Footprint of transportation and housing sector, and develop action plan for every regions in Wales (Phase V). Using Ecological Footprint as one of five headline sustainability

² The Madsar City is an eco-city, with large amount of seed capital provided by the UAE Government. This eco-city targets to have about 40,000 residents by 2025 and with additional 50,000 commuting every day for work or study, and the city will be fully powered by renewable energy. Transportation within the city is confined to electric buses, cars and other clean-energy vehicles with metro connecting with other cities. Currently all six buildings in the city use 100% sustainably sourced timber, green concrete (30 – 40% less carbon footprint), water-based paints that have no VOCs. The aim is to build Madsar city the world's most sustainable city.

indicators, the Welsh Government reports back annually to citizens, using Ecological Footprint to both set strategy and chart progress towards its one-planet goal.

It is worth noting that WWF also published Ecological Footprint Report in China in 2012, in partnership with several institutes including the Chinese Academy of Sciences³. Soon after, the China Center for Internal Economic Exchange (CCIEE), a high-level economic think tank headed by former Vice Premier Zeng Peiyan, launched a “Beyond GDP Indicators System” in partnership with WWF⁴. The indicator system aims to help evaluate the local governments’ achievement of green development, a goal of the 12th Five-Year Plan, and facilitate the development of China’s green economic policies. This indicator system encompasses GDP indicators as well as social and environmental tools such as Ecological Footprint. With such partnership approach to put Ecological Footprint as one of indicators into the national planning and evaluation process, China is well positioned to move towards Phase III, if it was included in the Global Footprint Network’s report (Appendix I)

A detailed account on the different phases achieved and activities initiated by selected countries is provided in Appendix I.

Hong Kong at the moment is at the Phase II of this five-phase framework, as WWF, on behalf of the Hong Kong Government, has initiated the research in Ecological Footprint and reviewed the status of Hong Kong.

It is recommended that, as the next step of raising awareness, measuring and announcing Hong Kong’s Ecological Footprint by the Hong Kong Government on a regular basis (as in Recommended strategy, *Short Term*), the Government should explore with relevant NGOs further to find the best way to adopt Ecological Footprint into the city sustainable development strategy and planning (Phase III). The existing government platform leading sustainable development in Hong Kong, Council for Sustainable Development, is well positioned to take the lead in the discussion of how Ecological Footprint could be integrated into Hong Kong’s long-term sustainable development, which also fits into the TORs of the Council⁵.

After progressing through Phase I to III smoothly, the Government could then set SMART goals and objectives to reduce Hong Kong’s Ecological Footprint (Phase IV), with reference to those nations which have already reached this phase such as Wales, UAE and Ecuador (see also Appendix I).

At the most advanced phase, the Government should discuss and work with various stakeholders and sectors in Hong Kong to make use of policy and investment shift to drive down Hong Kong’s Ecological Footprint in long term (Phase V). A number of cities have taken on the leadership role in using innovative way to develop water, air, mobility and building systems to reduce Ecological Footprint, as well as conserve

³ http://www.footprintnetwork.org/images/article_uploads/China_Ecological_Footprint_2012.pdf

⁴ http://awsassets.panda.org/downloads/en_2013_01_china_for_a_global_shift_newsletter.pdf

⁵ <http://www.susdev.gov.hk/html/en/council/index.htm>

their own biocapacity. A number of learning cases from cities worldwide including New York, Singapore, Toronto, Berlin, Stockholm, Calgary, Cape Town, Freiburg, Vienna, Chengdu and Mexico City has been analyzed and compiled by WWF⁶.

Recommended actions and implementation

1. By 2016, the Government starts measure and announces Hong Kong's Ecological Footprint on a regular basis.
2. By 2016, the Government has engaged with the relevant stakeholders to start initiatives in Hong Kong to raise awareness on the "over-consumption" issues and "Ecological Footprint" concept.
3. By 2020, the Government has adopted Ecological Footprint as one of the indicators to guide sustainable development strategy and planning for Hong Kong.
4. By 2020, the Government should have developed a roadmap which set target, processes and timeline to reduce Hong Kong's Ecological Footprint.

Expected outcomes

By 2020, Hong Kong's citizens are well aware of the issue of "over-consumption" and the concept of "Ecological Footprint", and the Government has a clear roadmap to reduce Hong Kong's Ecological Footprint.

Evaluation and monitoring

To be discussed by NGOs and the Government.

⁶ http://awsassets.panda.org/downloads/urban_solutions_for_a_living_planet_final_version_2012.pdf

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Appendix I: National use of the Ecological Footprint.

NOTE: compiled by Global Footprint Network in 2012

National Use of the Ecological Footprint

A briefing on current and past national research collaborations and official Ecological Footprint reviews

Global Footprint Network's Direct Work with Countries

Europe

Now representing the world's largest economy, the European Union has undertaken a two-year, 1.5 million Euro program called One Planet Economy Network (OPEN) EU, aimed at building an economy that works within nature's means. The core of the project is the creation of a Footprint tool that enables European decision-makers to explore future scenarios and create evidence-based policy that respects ecological limits.

The tool, called EUREAPA, is being created through a collaborative effort by Global Footprint Network, Stockholm Environmental Institute (SEI), WWF-UK, Twente University, SERI and Ecologic. EUREAPA will provide data for a "footprint family of indicators," including carbon Footprint, water footprint and Ecological Footprint in a way that allows them to be integrated and compared. The tool will enable policy makers to forecast and back-cast, assess policy options and produce scenarios for any EU country or the EU as a whole.

In addition to its applications through OPEN EU, participating in the project will allow Global Footprint Network to lay the foundation to implement our Science and Technology Roadmap. For example, it will enable us to provide a more powerful multi-lateral tradeflow analysis that provides the means to compare products and sectors. Such analysis can help governments direct investment toward more resource-efficient goods and services and promote greener ways of meeting market demand.

United Arab Emirates

When, in 2007, the United Arab Emirates was reported as the country with the largest Ecological Footprint per person in the world, officials were determined to learn why. The government [launched Al Basama Al Beeiya \(the Ecological Footprint Initiative\)](#) to understand the numbers and methodology behind the ranking. [\(Learn more about the UAE's Ecological Footprint\).](#)

UAE scientists are working with Global Footprint Network [to test the potential of various policies](#) to reduce the Footprint of the electricity sector, one of the largest

components of the country's outsized ecological demand. Local partners on the ground, including Emirates Environmental Group, Abu Dhabi Global Environmental Data Initiative (AGEDI) and Emirates Wildlife Society - WWF are working to build support for large-scale change and teach people about action they can take in their own lives, through efforts such as this [educational video](#).

In just three years of direct engagement, Global Footprint Network has seen the United Arab Emirates progress through all five phases. Since initiating an Ecological Footprint project in 2007 to better understand its National Footprint Accounts, the UAE has invested in the creation of a national statistical office to support collection of environmental data, earmarked \$15 billion dollars of investment into alternative energy, \$22 billion to create Masdar (a zero-waste, zero-carbon ecocity to serve as a model for sustainable development), and has created the innovative Masdar Institute of Science and Technology (MIST). We are now working with UAE scientists on a scenario tool to transform first their electricity sector followed by other sectors of the economy.

Al Basama Al Beeiya Initiative:

<http://www.agedi.ae/English/national/EcologicalFootprint/Pages/default.aspx>

Japan

After completing an extensive internal review of Japan's National Footprint accounts research, the Japanese government has adopted the Footprint as part of Japan's Basic Environmental Plan. In addition to informing environmental policy and goals, Ecological Footprint accounting is being used to inform and educate the wider public about the country's resource demands and trends. The [Japan Ecological Footprint Report 2009](#), which identified leading areas of ecological demand and offers policy recommendations to address them, reached an audience of well over 8 million people and fueled a growing call to action at both the individual and government levels. The report has been used to engage environment ministers on specific plans of action to more sustainably manage resource demand. Global Footprint Network is working with WWF Japan to complete a follow-up Japan Ecological Footprint Report, to be launched in 2012.

Indonesia

Indonesia's Ministry of Public Works has completed a report on the country's Ecological Footprint as a basis for informing policy that can guide the country on a development path that does not compromise its rich natural capital.

According to the report's preface, "Implementation of sustainable development has to be based on complete knowledge of existing conditions and the desired state in the future." The report was initiated by the Directorate General of Spatial Planning in an effort to assess current biocapacity and Ecological Footprint conditions to the best extent possible. The report notes that Indonesia has a wealth of biocapacity, but in some places – particularly Java and Indonesia – high population threatens that surplus.

Global Footprint Network is working with the Ministry of Public Works to develop a project to provide in-depth capacity building for government officials and other

Footprint practitioners and complete a thorough analysis of the drivers of Indonesia's resource demand, looking specifically at key sectors of the Indonesia economy.

[Click here](#) to read the Ministry of Public Works' report.

Philippines

The Philippines is on track to adopt the Ecological Footprint at the national level. In 2011, the government began exploring ways to incorporate the Ecological Footprint into its proposed National Land Use Act for 2012. The legislation, a comprehensive national land-use policy, will protect areas from haphazard development and plan for the country's use and management of the country's physical resources. The government will continue to work with Global Footprint Network in 2012 to make the Philippines the first country in Southeast Asia to adopt the Footprint at the national level.

Ecuador

In the past five decades, Ecuador has seen its vast ecological surplus evaporate. In 1961, the country had biocapacity more than four times greater than its Ecological Footprint; today, however, its Ecological Footprint almost equals its biocapacity and will quickly exceed it if current trends continue. To reverse this trend, Ecuador has committed in its National Plan that by 2013, the country's Footprint will not exceed its biocapacity and that it will remain so going forward.

The country also adopted a Presidential mandate to develop physical indicators that can better track environmental performance and support decision-making. Officials have said they hope the country's leadership in using the Ecological Footprint as a resource accounting tool will inspire policy-makers elsewhere to follow suit. Officials are walking the talk. Ecuador recently launched Yasuní ITT: an ambitious initiative to preserve one million acres of the Amazon rainforest by keeping the country's largest undeveloped oil reserve—846 million barrels worth—permanently in the ground. The plan will keep 407 metric tones of CO₂ out of the atmosphere, maintain a key source of Ecuador's natural wealth, and safeguard the livelihood of indigenous cultures from the region.

Global Footprint Network is working to develop a multi-year collaboration with the Ministry of Environment and the Ministry of Planning (Secretaría Nacional de Planificación y Desarrollo) to provide strategic advice and technical support on the Ecological Footprint for Ecuador to achieve its Footprint reduction goals.

Peru

In 2008, Peru created a Ministry of Environment to deal with the challenges of biocapacity management and consumption, and in 2010, as part of the Ministry's first full budgetary cycle; it dedicated funds to work with the Footprint. "For us, it is of particular importance to have information and indicators that account for our growing demand on the biocapacity of the planet to meet our needs," Environment Vice Minister Ana María González del Valle Begazo wrote in an official letter of interest.

Global Footprint Network has worked with Peru-based consultancy Libélula (Dragonfly) to develop a method of analysis that will reflect the broad differences in biocapacity and consumption levels of various regions. Global Footprint Network is working to sign a Memorandum of Understanding with the fledgling ministry to promote this work in 2012.

Community of Andean Nations (CAN)

The CAN and its member nations – Ecuador, Colombia, Bolivia and Peru – began working with Global Footprint Network in early 2009 on an initiative to maintain one of the CAN region's richest and most important assets: its natural resource base. The initiative seeks to demonstrate the interdependence between a country's natural wealth, its economic health and, ultimately, the well-being of its people.

As part of the initiative, the CAN launched a [video](#) (in Spanish; see below) that explains this lofty concept in terms almost any family can relate to. "It's as if a family needed to adjust expenditures because of having another child," the video explains, "yet nevertheless, in spite of these forces, the family continued to spend more money." Now, however, the video says, the CAN is working to address that situation – in particular Ecuador, which has adopted specific Ecological Footprint reduction goals.

The CAN has also released a preview version of a report on the Ecological Footprint of the CAN countries that was released with Global Footprint Network in 2010. The teaser, which introduces people to the concept of the Ecological Footprint and provides a snapshot of the data, can be downloaded here in [English](#) and [Spanish](#). The longer report will provide an in-depth look at the ecological trends in each of the member countries, along with perspectives and commentary by in-country experts.

Colombia

Global Footprint Network collaborated with partner organization [ALISOS](#), a nonprofit organization, based in Bogotá that is committed to promoting a new model of sustainable development, which combines natural capital, economic, social and cultural rights in Latin America from multi-sectoral dialogue and partnerships, on these events. ALISOS coordinated the events and meetings in Bogotá during November of 2011. Over the course of three days Mathis and Dr. Juan Carlos Morales, Global Footprint Network's Director of Research & Standards participated in 11 events, including meetings with the Central Bank of Colombia, the National Planning Department, the Environment and Sustainable Development Ministry, the Colombian Institute of Hydrology, Meteorology, and Environmental Studies, international cooperation agencies (Dutch Embassy, Swedish Embassy, USAID, and GIZ), CEOs from 16 private sector companies, and representatives from Colombia's most influential environmental NGOs (Etnollano, CECODES, Gaia Amazonas, Patrimonio Natural).

The Colombia workshops were also incredibly important for the development of Global Footprint Network's newest program: Competitiveness 2.0. Competitiveness 2.0 argues that resource constraints have become a leading factor in determining economic success — or crisis — in the 21st century and we have the research to prove this. The Colombia meetings served as a first testing ground for these arguments and our success on this trip demonstrates the resonance and potential of this new approach. We also received useful feedback that has helped us to refine our messaging and drive the research agenda. For instance, we now realize that central banks might be a great entry point since they represent a neutral ground, are interested in the longer term economic stability of their countries and less susceptible to electoral politics. In fact, the Director of the Central Bank of Colombia even highlighted how they have come to realize that with resource driven inflation, they can no longer use their traditional inflation-fighting tools and need something else. Ultimately, this trip was a crucial opportunity to test our Competitiveness 2.0 strategy with a potential client. We now have a stronger argument and implemented key lessons on how to structure our workshops and meetings to extract the most impact.

Costa Rica

The Ecological Footprint and biocapacity data for Costa Rica were included for the first time in the country's annual [State of Nation report](#), an overview of national social, economic, environmental and political issues. In it, Steffan Gómez, the report's chief researcher, attributed the country's growing Footprint to its increased consumption and pollution. The Ecological Footprint was one of several indicators used in the report to provide information relevant to public policy on sustainable human development.

Global Footprint Network President Mathis Wackernagel traveled to Costa Rica in February 2012 for a series of high-level meetings and workshops to introduce the Footprint concepts and Competitiveness 2.0 analysis to a wide spectrum of stakeholders. Global Footprint Network is following up on this trip to develop a comprehensive project to develop and deploy the Competitiveness 2.0 framework in Central America, beginning with El Salvador and then rolling out the initiative to Costa Rica.

El Salvador

Global Footprint Network President Mathis Wackernagel also went to El Salvador in February 2012, where met with the Vice-president and Director of the Central Bank, the Minister and Vice-minister of Economy, the Minister of Tourism, FUSADES - Fundación Salvadoreña para El Desarrollo Económico y Social (El Salvadoran Foundation for Economic and Social Development), and the rector of UTEC - Universidad Tecnológica de El Salvador (Technical University of El Salvador).

These meetings were coupled with several high-profile interviews with La Nación in Costa Rica and Canal 33 in El Salvador to increase the awareness and

understanding of the Ecological Footprint in these countries where the concepts are still quite new.

For all of these meetings the goal was to present the Competitiveness 2.0 argument and inspire countries to engage with us around revising their competitiveness plans. We found strong resonance among business leaders and also ministers, and academic institutions. It was not just about bad news, but how the rules of the game are shifting, and why they need to start looking for the new intervention points that can help reduce their risk exposure and find new opportunities to be successful.

In El Salvador in particular there is high potential to engage with the national government around these topics. Both the Central Bank and the Ministry of Economy expressed clear interest in collaborating with Global Footprint Network. The Minister of Economy pointed to three venues they would like to include in a potential collaboration: the national economic intelligence unit, the central statistics agency, and the National Energy Council. We are now working with Roberto Artavia and VIVA Trust to develop a proposal for collaboration with El Salvador, as well as a strategy to roll out this type of engagement to Costa Rica once we are successful in El Salvador.

Wales

Wales is pursuing an ambitious goal: It has pledged, within the lifetime of a generation, to reduce its per capita Ecological Footprint to the global average biocapacity available. Its One Wales: One Planet campaign strives to match ambition to action. The government has launched programs to reduce the Footprint of transportation and housing, and is working with local authorities to develop low-carbon action plans for every region in Wales. Using the Ecological Footprint as one of five headline sustainability indicators, the government reports back annually to citizens, using the Footprint to both set strategy and chart progress toward its one-planet goals.

- Read the Welsh Assembly Government's most recent [sustainability report](#) detailing its action plan for reducing its Footprint.
- Read the [One Planet Wales](#) report, that shows how Wales can reduce its Footprint and transform its economy
- Learn more about the [Welsh Assembly Government's](#) sustainability goals and initiatives

External Reviews of the Ecological Footprint

The European Commission, United Kingdom, United Arab Emirates, Finland, Japan, Belgium, Luxembourg, Germany, Ireland, Indonesia, Spain, France, Ecuador, Peru and Colombia are countries and intergovernmental bodies that have done or are doing reviews of the National Footprint Accounts through third party reviews or in direct collaboration with Global Footprint Network.

European Commission

After a comprehensive, [two-year study of Ecological Footprint methodology](#), the European Commission has found the Footprint to be a useful indicator for assessing progress made toward the E.U.'s sustainability goals. The Footprint is unique among the indicators, according to the Commission's report, in particular for its ability to relate resource use to the concept of carrying capacity. The report also praised the Footprint as an "intuitively appealing indicator", easy to communicate and understand.

The Commission began its evaluation of the Footprint as part of an effort to measure progress toward long-term sustainability goals. Recognizing that using resources more efficiently is crucial both to the region's economic development and its positive role in the world, the European Commission set clear policy objectives to limit environmental impacts and enable greater resource efficiency. A key obstacle, however, has been the lack of suitable indicators to establish targets and measure progress.

In 2008, the Commission completed a study to evaluate the Ecological Footprint as an indicator, examining its advantages as well as its shortcomings. The study found the Footprint could be an effective tool for assessing and communicating progress toward objectives, especially when combined with a basket of complementary indicators. The study also noted areas where the indicator could potentially be improved, and identified a short-to-medium research agenda for advancing the National Footprint Accounts methodology.

Learn More:

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- [Learn about the review](#)
 - [Download the Executive Summary](#)
 - [Download the Full Report](#)
 - [Download the Eurostat "Ecological Footprint and Biocapacity" report](#)

European Parliament

In 2001, the report [Ecological Footprinting](#) was released by the Directorate General for Research, Division Industry, Research, Energy, Environment, and Scientific and Technological Options Assessment (STOA), 2001. The report, commissioned by the European Parliament, presents arguments and evidence reviewing the Ecological Footprinting methodology, comparing it with official and non-official indicators that are currently under development. The report is the result of a study conducted by ECOTEC Research and Consulting, whose aims were to review the Ecological Footprinting methodology; summarize recent studies on Ecological Footprinting undertaken internationally; critically assess whether the methodology addresses the physiological, environmental and ecological concerns of the European Union as expressed in its legislation and other official documents; and assess the strengths and weaknesses of the methodology in comparison to other methodologies of comparable scope.

[Click here](#) to read the report.

[Click here](#) to access the Directorate General for Research, Division Industry, Research, Energy, Environment, and Scientific and Technological Options Assessment (STOA), 2001, Ecological Footprinting

Switzerland

In December 2006, Switzerland became the first country in the world to complete a review of its National Footprint Accounts. The government published the review as a report entitled [Switzerland's Ecological Footprint - A Contribution to the Sustainability Debate](#). The study was carried out by INFRAS, a leading Swiss policy research institute. INFRAS compared the international data sources used by Global Footprint Network to the statistics used by the Swiss Federal Statistical Office, and concluded that the data sets are largely consistent. The researchers also closely examined the Ecological Footprint approach, and calculated Switzerland's Ecological Footprint. The publication contains a multitude of easy to read charts showing how Switzerland's demand on nature compares with that of other countries. The publication also includes background information enabling readers to assess the Ecological Footprint approach. In addition, this collaborative study helped identify possible improvements for the accounts, which will enhance the Footprint calculations for all 201 countries.

[Click here](#) to learn more about Switzerland's Ecological Footprint.

France

France has conducted reviews of the Ecological Footprint as a step toward considering it for adoption as a national sustainability indicator. The first review, conducted by France's Economic, Social and Environmental Council, looked at the general assumptions of the Ecological Footprint and other sustainability indicators. It was released in May 2009.

[Click here](#) to read the Economic, Social and Environmental Council report. The second report, completed in 2010 and conducted by the Statistical Office of the French Ministry for Sustainable Development (SOeS) looked at, among other issues, the transparency and replicability of the Ecological Footprint methodology. They were able to reproduce the time series for the French Footprint and biocapacity within 1-3 percent.

[Click here](#) to visit official Internet page of the report (in French, 9 MB).

[Click here](#) to read the French SOeS report "Une expertise de l'empreinte écologique" (in French, 9 MB).

[Click here](#) to read an English extract from "Etudes & documents: An expert examination of the Ecological Footprint" (2010).

[Click here](#) to read the French report “Sustainable Development Indicators and the Ecological Footprint,” 2009 (in French).

Stiglitz Commission Report

In 2007, French President Nicolas Sarkozy created the Commission on the Measurement of Economic Performance and Social Progress to look into the issue of how we could move beyond GDP to broader indicators of progress that could assess whether countries are providing for human well-being in a meaningful and lasting way. Chaired by Nobel Prize winning-economists Professor Joseph E. Stiglitz of Columbia University and Professor Amartya Sen of Harvard, the Commission issued a report in late 2009, which included extensive discussion of the Ecological Footprint as a possible indicator.

Learn More:

- Read the [report](#).
- Read Global Footprint Network's [response](#).

Spain

In 2008, the Spanish government completed an analysis of the Ecological Footprint of Spain. The report analyzed Spain's Ecological Footprint and its various components such as energy, forest land, etc; the country's ecological deficit; and regional variations in biocapacity and consumption; and discussed how these might be relevant to policy. The report also made recommendations as to possible improvements in methodology and source data.

[Click here](#) to download the report (in Spanish).

Luxembourg

Luxembourg's National Advisory Council for Sustainable Development (CSDD) commissioned the Resource Centre for Environmental Technologies (CRTE) in December 2008 to conduct a technical study for the establishment of the Ecological Footprint for Luxembourg.

The objective of the study was to analyze the Ecological Footprint calculations for Luxembourg done by Global Footprint Network and give an overview of the significance of the results for Luxembourg with respect to national particularities. It aimed to correctly define the boundaries of the Ecological Footprint assessment for Luxembourg and address methodological issues relevant at the national level, including data quality. The study is intended as a basis for future yearly calculation of Luxembourg's Footprint by Global Footprint Network in conjunction with national offices and organizations.

[Click here](#) to read the Luxembourg report.

[Learn more](#) about Luxembourg's Ecological Footprint.

Germany

The Ecological Footprint has proven one of the most successful indicators for communicating the concept of environmental sustainability and the physical limits of our planet. In the past decade the Ecological Footprint has developed into one of the most important measures for resource use in production and consumption at the international level. The objective of the project [Scientific assessment and evaluation of the indicator "Ecological Footprint"](#), commissioned by the Federal Environment Agency (UBA) in Dessau, Germany, was to assess and evaluate the Footprint for its possible use as a national sustainability indicator for Germany. The project was a corporation between the Sustainable Europe Research Institute (SERI), Vienna, Austria, Ecologic, Berlin and Best Foot Forward (BFF) in Oxford, UK.

The project had four major objectives:

1. Describe the state of the art of the calculation of the Ecological Footprint and provide a review of existing calculation methods.
2. Analyze underlying data using the National Footprint Accounts of Germany and present the main problems with regard to data quality. Identify and assess alternative national data sources for Germany.
3. Critically analyze existing Ecological Footprint calculations with particular focus on the weak points in the calculation method as well as the meaningfulness and interpretability of the indicator.
4. Formulate and present recommendations on how identified weak points could be improved (in particular with regard to data sets and calculation methods), and identify in which fields of application the Ecological Footprint seems appropriate.

To read the full report, [click here](#).

Belgium

In 2010 the Belgian Ministry for Planning (Bureau fédéral du Plan) (PLAN) conducted a review of the Ecological Footprint and produced a report which was also discussed in a press release and a media story (all three in French). PLAN's report discusses at length the strengths and weaknesses of Ecological Footprint and biocapacity accounting. This study was one of the two that looked in more in depth at the 88 federally selected indicators of the Belgium government.

Read more about Belgium's working papers (French) [Biocapacity and Ecological Footprint Indicators \(fr\)](#) and [Pressures on the environment by consumption in Belgium in 2002: an analysis sociological \(fr\)](#)

See the [French Press Release](#).

UK/DEFRA

In 2007, the UK Department for Environment, Food and Rural Affairs (Defra) commissioned a study by independent consultancy Risk & Policy Analysis Ltd. to assess developments since 2004 in Ecological Footprinting methodologies and their

practical application. The goal of the study was to evaluate the usefulness of the Ecological Footprint for policymaking in the UK. The [final report](#), *A review of recent developments in, and the practical use of, Ecological Footprinting methodologies*, was released in late 2007.

[Click here](#) to read the Global Footprint Network review of the report.

Ireland

[Click here](#) to read the EcoFootprint analysis Ireland's Environmental Protection Agency completed on the Ecological Footprint.

Background on Ecological Footprint Method:

In addition to these papers, additional information on the Footprint calculations and methodology can be found in the [Footprint Science](#) section of Global Footprint Network's website. The

Global Footprint Network: Frequently Asked Questions on Methodology

http://www.footprintnetwork.org/en/index.php/GFN/page/frequently_asked_technical_questions/#method

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<http://www.footprintnetwork.org/en/index.php/GFN/page/glossary/#globalhectare>

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Final Report of the Sustainable Use, Ecological Footprint and Ecosystem Services
Focus Group Submitted to Awareness, Mainstreaming and Sustainability Working
Group of the Biodiversity Strategy and Action Plan (BSAP) Section II – Sustainable
Use of Biodiversity

Title

Addressing sustainable use of biodiversity for Hong Kong

Relevant Aichi Biodiversity Targets

Sustainable use of Biodiversity: T4, T6 and T7

Group leader

C.W. Cheung

Key experts / stakeholders who were involved in the discussion

- a) Within the Steering Committee/ Working Groups
Mr. C.W. Cheung, Dr. Andy Cornish, Ms. Sophie Le Clue, Ms. Idy Wong
- b) Outside the Steering Committee/ Working Groups
Mr. Ken Chan, Dr. S.T. Chiu, Dr. Gunter Fischer, Dr. Yannick Kuehl, Dr. Karen Lee, Mr. Alistair Monument, Mr. Stanley Shea, Ms. Anastasiya Timoshyna, Dr. Allen To (report coordinator), Ms. Tracy Tsang

Objective

- a) To examine the status and impact of use of biodiversity in Hong Kong and to address areas of major ecological burden on biodiversity outside Hong Kong

Scope

Sustainable use of Biodiversity: Aichi Targets T4, T6 and T7

- a) Review areas of local consumption which poses significant impact to biodiversity outside Hong Kong
- b) Identify any knowledge gaps and propose recommendations to HK Government for identified commodities where Hong Kong's impact is, or is considered likely to be significant

Methodology

- c) Desktop research – individual experts worked on specific areas / commodities or collaboratively on the whole assessment framework, based on published literature and reports available.
- d) Trade profile analysis – Census & Statistics Department data was used, either as retrieved via AFCD or through FG members' own research. Data were used to analyze the global significance of selected traded commodities in Hong Kong.

Sustainable Use of Biodiversity

Despite its relatively small population size, Hong Kong's position as a major trading hub and consumer of many plants and animals both in terms of species and volume, mean it has potential biodiversity impacts of local, regional and/or global significance. As such Hong Kong's use of resources require due consideration under BSAP 2015 – 2020.

The FG has addressed Hong Kong's use of both its own natural resources, as well as external resources that may have such impacts.

While we worked on a list of relevant commodities which are consumed locally and normally imported (traded) from around the world, pure wildlife trade commodities (with low consumption) are being dealt with separately by the other working group(s).. The following section presents the findings of this assessment and is structured in two parts.

Part A provides an overview of scope and methodology. Importantly, it highlights key issues relevant to Hong Kong's sustainable use of resource and biodiversity, including overall strategy considering some of the crosscutting issues,

The existing status, gaps, specific strategies, actions and recommendations pertaining to individual commodities or groups thereof are presented in Part B.

Part A - Overview

Scope and Methodology

The FG compiled a list of commodities which are relevant in terms of their biodiversity impacts globally. These commodities were selected based on the following:

- 1) **Criteria and results generated by Market Transformation Initiative, WWF.** This identifies a dozen commodities that have the greatest impacts on biodiversity, water and climate. Taken together, these priority commodities include the largest drivers of deforestation, main sources of greenhouse gas emission from land use, most important fisheries and critical impact on livelihoods of hundreds of millions of people especially on many of the poorest on the planet (WWF 2012). This list can be found at: [http://www.panda.org/what we do/how we work/businesses/transforming markets/](http://www.panda.org/what_we_do/how_we_work/businesses/transforming_markets/)
- 2) **FG's expert advice.** A number of commodities, not listed by the Market Transformation Initiative, were considered potentially significant in terms of the local and regional context, given both consumption and the leading role Hong Kong plays in the trade of that commodity. Examples of these include, but are not limited to, sharks, live reef food fish (live groupers, wrasse) and seafood in general.

A list of the commodities, their relevance to Hong Kong, existing status, key areas of biodiversity concern/impact, gaps and recommendations was subsequently compiled. FG then developed the following criteria to prioritize the importance of the selected commodities for incorporation into BSAP 2015 – 2020. Those not prioritized and the associated justifications are presented in Appendix I.

Prioritization

- 1) Urgency for action with respect to BSAP timeframe
Conservation efforts must be in place in 2015 – 2010 to prevent an irreversible biodiversity loss.
- 2) Critical impact with respect to global significance of Hong Kong
The volume of unsustainable trade of specific commodities is significant and substantial with reference to the global trade.

The upward trend of unsustainable trade of specific commodities has posed an accelerating threat and/or burden to biodiversity.

Identified Foci

Based on these three criteria, FG identified the following as priority areas/commodities for incorporation into BSAP 2015 – 2020:

- Seafood
 - Other Seafood (Wild Caught) (Excluding Sharks / LRFF)
 - Other Seafood (Aquaculture) (Excluding Sharks / LRFF)

- Live Reef Food Fish (LRFF)
- Sharks
- Manta and Devil Ray Gill Raker / Gill Plate / Ray Fins
- Timber
- Paper
- Traditional Chinese Medicine TCM (Wild-Caught or Wild-Collected)
- Beef

Summary of recommendation for prioritized commodities

While recommendations with respect to specific areas or individual commodities are presented in Part B 1 – 5, the FG highlights the following key crosscutting recommendations to address both the drivers and threats behind unsustainable use of the priority areas/commodities. Detailed recommendations relevant to each of these commodities are presented in Part B.

1) Fill up the research gap

It should be noted that, there are currently important signs but insufficient research to confirm the status and the impact of some commodities, specifically with respect to the trade in rays and farmed Traditional Chinese Medicine (TCM) in Hong Kong. FG identified this as a potential area for BSAP's concern in view of the notable signs of an expanding local market for rays despite the threatened nature of at least 107 species (not accounting for data deficiency); and the wide coverage of farmed species, increasing popularity and extensive use of TCM in Hong Kong. For trade such as those concerning animals and plants collected or farmed for food, horticulture, pet and fashion accessories trade, there is a lack of relevant data and research regarding the species / species group (see Part B). Further study is needed to look into these issues.

In addition, the sustainability of much of the seafood available in Hong Kong market is largely unknown. As well as being an issue of biodiversity conservation, this is also an issue of food security given Hong Kong's appetite for seafood coupled with its dependence on Asia for 80% of these resources; notably a region where scientists point to the persistent mismanagement of fisheries such that fish stocks and Catch Per Unit Effort are in significant and worrying decline.

It is recommended that research be carried out to fill these knowledge gaps to inform policy development and inform the community in making sustainable choices.

2) Improve and make use of Census & Statistics Department's trade data to monitor the trade of specific area/commodities of BSAP's concern

The trade data described via the "Hong Kong Harmonized System" (HKHS) as maintained by the Census & Statistics Department' is an existing and useful resource that has strong potential to support trade analysis and monitoring of the commodities' trade and trends relevant to BSAP. There is a need to improve the commodity coding system of HKHS, to address some of the biodiversity impacts highlighted in Part B, notably to species relevant to BSAP. In particular

recommendations are provided for shark, rays and TCM (for example “gecko”). A more comprehensive import statistics system of all LRFF imported into Hong Kong is also recommended, given the significant monitoring and data gaps in the existing regulatory system.

3) *Create access to information related to illegal trade of specific commodities of BSAP’s concern*

In view of the large trade volume of some of the priority commodities, the limited regulatory control and the implications for illegal products entering Hong Kong markets (such as Illegal, Unreported and Unregulated seafood, LRFF, shark, timber, paper and TCM), the FG recommends the BSAP to consider establishing relevant legal frameworks to preclude Hong Kong from becoming an “illegal product trade hub”.

Traceability requirements to tackle IUU in particular are increasing globally, led by the EU and more latterly by the USA and Hong Kong is in danger of being at odds with such requirements.

In addressing the gaps, a better reporting and monitoring system (as also suggested in Recommendation 2 above) is key. To empower relevant Hong Kong Government departments to work on this front, it may be relevant to leverage on global legal framework and best practices, for example, officially implement monitoring and regulation set out by Regional Fishery Management Organizations (RFMOs) and implementation of comprehensive Port State Measures in Hong Kong (noting that an increasing number of countries are already doing so) to address the issue of importing IUU seafood including LRFF, sharks and rays.

The seizure of records of illegally traded wildlife held by Hong Kong Customs and Excise Department also have strong potential to support analysis and monitoring of the trend and pattern of trade of BSAP’s concern. There is need to improve access to these records and breakdown the data system to species level to facilitate research being carried out to fill information gaps to better understand Hong Kong’s position in illegal trade of increasingly endangered species and inform policy development/regulation.

4) *Strengthen CITES law enforcement and licensing system in Hong Kong*

There are considered weaknesses as regards the enforcement of CITES in Hong Kong. For example it is known that species such as Humphead Wrasse have been imported into Hong Kong with no corresponding import licenses; the lack of reporting by Hong Kong registered fishing vessels exacerbates the situation and provides a loophole for smuggling; and the numerous ports for landing make enforcement a challenge. Furthermore without use of DNA analysis for certain species/ animals or parts thereof e.g. sharks, identification and thus enforcements is a challenge.

It is recommended to address these issues through a combination of addressing specific legal issues as noted in Part B and strengthening training of frontline staff on species identification and licensing control. These actions are especially important

and urgent for controlling trade of sharks, LRFF, orchid and agar wood. It is also recommended to make effective use of DNA barcoding technique in law enforcement and trade analysis.

5) *Promote sustainable production and consumption of basic commodities of BSAP's concern*

Building on the recommendations above, there is a need to create accessibility of sustainable products in Hong Kong and promote public support of eco-labels that are relevant to the identified commodities of BSAP's concern. This should for example cover, but not be limited to, Forest Stewardship Council (FSC), Marine Stewardship Council (MSC), Roundtable on Sustainable Palm Oil (RSPO), Aquaculture Stewardship Council (ASC).

In view of the growing popularity, extensive use and the wide coverage of wild-caught/collected species, TCM is regarded as highly relevant to BSAP in Hong Kong. To address its biodiversity impact, it is recommended that the FairWild certification for sustainable TCM product should be introduced to the Hong Kong market and government should provide incentives to promote certified TCM product.

6) *Bridge public awareness and action for biodiversity conservation*

It is recommended to set "sustainable use of resources" as a core component of BSAP's education programme to engage public participation for biodiversity conservation. Basic commodities, such as palm oil which is widely built in a wide variety of products, can be used to arouse public awareness of relationship between biodiversity, commodity production and commodity consumption. It can also be used to illustrate the necessary actions for, and the benefits of, biodiversity conservation.

7) *Regulate trade in resources*

There are no regulations that cover the purchase of illegally logged timber and paper products or regulate against unsustainable timber or paper. Similarly there are no regulations covering the seafood trade other than CITES and claims as regards TCM. The Australian government estimates the global economic cost of illegal logging being approximately US\$46 billion a year, whilst global social and environmental costs add up to around US\$60.5 billion per year.

In the US, the Lacey Act was enacted in 1900, with an aim to prohibit illegal trade in wildlife, fish and plants. It was amended in 2008 to extend its reach to a broader range of plants and animal products and to prohibit taking any plant or plant product out of any country in violation of its natural-resource laws and thus including illegally logged wood. Companies now trading forest products into the US must provide with each shipment a declaration to the relevant authorities presenting the countries of harvest and the species involved.

In the European Union, the EU Timber Regulation (Regulation 995/2010) was adopted in 2010 to prevent sales of illegal timber and timber products on the EU internal market. The Australian Illegal Logging Prohibition Act (2012) follows the EU approach by requiring a due diligence system, and compatible legislations are being

developed in timber producing countries in Asia as well as in consuming and trading countries such as South Korea, Vietnam, Japan and mainland China.

Given Hong Kong's role as a trading hub and the increasing pressure we place on biodiversity in the region and around the world as we consume unsustainably, it is considered that the Hong Kong Government should review provisions such as those under the Lacey Act to regulate its trade and conduct a scoping study on the extent of illegally-sourced commodities in Hong Kong. The feasibility of adopting potentially similar legislation should be assessed. Civic Exchange is concurrently undertaking a study on the Lacey Act for Hong Kong.

Part B - Commodities Evaluation and Recommendations

B1. Seafood Overview

B1.1 Seafood (Wild Caught) (Excluding Shark / LRFF)

B1.2. Other Seafood (Aquaculture) (Excluding Shark / LRFF)

B1.3. Live Reef Food Fish (LRFF)

B1.4. Sharks

B1.5. Manta and Devil Ray Gill Raker / Gill Plate / Ray Fins

B2. Timber

B3. Paper

B4. Traditional Chinese medicine (wild)

B5. Beef

Appendix I: Commodities reviewed but not prioritized for BSAP 2015 – 2020

Appendix II: Summary of Science based research indicating shark species and population declines

Appendix III: Summary of a literature review on the shark academic researches related to global shark fin trade

B1. Seafood Overview

PIC: Allen To, Stan Shea, Sophie le Clue, Tracy Tsang

The seafood commodities assessed generally have in common, large trade volume of global significance, a large number of threatened species in the trade, mismanagement of resources globally, and weak regulation. These issues increase the potential for biodiversity impacts. A common theme is improved monitoring and traceability and specific recommendations have been provided depending on the commodity. Overall, Hong Kong does little to regulate its burgeoning seafood trade other than through CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). While it is encouraging to see that potential participation in CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) was recently proposed, this just addresses the tip of the iceberg for Hong Kong. The overall strategy is to gather data and plug information gaps, address loopholes in existing regulations, facilitate better regulation where possible (CITES can be one of the tools), provide education on sustainability of seafood resources to the public and importantly for Hong Kong to be a leader in areas where it can have significant impact.

B1.1 Seafood (Wild Caught) (Excluding Shark / LRFF)

PIC: Allen To, Stan Shea, Sophie le Clue

Hong Kong's status (role and utilization)

According to Census and Statistics Department trade data, from 1992 – 2011, Hong Kong imported as much as 90% of its seafood from over 170 countries and all continents of the world. Importantly, about 80% of this was imported from other

Asian countries, with China alone supplying 44% of Hong Kong's imports that year. Time series data show that these numbers have been reasonably stable for the last ten years.

This data underscores the importance to Hong Kong's role as a significant consumer of resources and seafood trading hub at a time when the lack of sustainable management of fisheries in the region is of grave concern as regards to both biodiversity and food security.

The per-capita seafood consumption in Hong Kong has been increasing over the past few decades and the latest figures from FAO indicate seafood consumption in Hong Kong continues to rise and is 77.5 kg per capita, ranking 2nd in Asia and 6th globally (FAO 2013).

Based on the WWF Seafood Guide, an array of seafood in HK's market has been assessed and is considered unsustainable whether wild caught or farmed. There is currently insufficient information however such as a lack of trade records with sufficient details e.g. species name and source such as wild caught or farmed, to say exactly what percentage of imported seafood is from unsustainable sources.

Nevertheless, a survey conducted by WWF in mid-2013 at 48 Chinese restaurants, seafood restaurants and supermarkets, specifically looking at live seafood, revealed that approximately 50% of the species found in live seafood tanks were listed in the Seafood Guide as "Red – Avoid" category.

Key Areas of Biodiversity Concern/ Impact

Species: There is no comprehensive study to report on the number of species involved in the seafood trade in Hong Kong. However from available data it is estimated that many species classified as "Threatened" according to IUCN are regularly imported into HK. For example in addition to live reef food fish and sharks (which are reported on in following sections of this report), Atlantic Bluefin Tuna, Southern Bluefin Tuna, eels, a number of wild caught sturgeon produced caviar, Atlantic cod and the spiky sea cucumber. Other than these already "Threatened" species, numerous other species are experiencing various levels of decline in population due to high fishing pressure and lack of import controls e.g. orange roughy, toothfish and swordfish.

Notably, gaps in current legislation as regards to the potential import of IUU seafood are evident for several species such as toothfish (WWF 2010), Atlantic bluefin tuna (WWF 2012).

Habitat: The level of impact on habitat varies according to seafood harvesting methods used and which in the region include most forms of destructive fishing practices that can degrade or destroy marine habitats, such as unregulated bottom trawling.

Ecosystem: The huge bycatch issue in some fisheries such as the seal, sea birds, sharks and marine mammal entanglement through long-line fishing, gill-net and purse seine. Many of the species caught are already "Threatened" species.

Gaps Identified

1. Loopholes in the trade in some seafood species such as Toothfish and Atlantic Bluefin Tuna have been highlighted by WWF-Hong Kong for both cases, but local legislation which aligns with international trade monitoring and regulatory systems is lacking or just starting to materialize. Apart from the implementation of CITES which provides trade restrictions on a fairly limited number of marine species, Hong Kong does not implement traceability requirements or trade regulation that would address some of the areas of biodiversity concern driven by overfishing and use of destructive gears in the region. It should be noted that this is at odds with increasing global concern and action addressing the trade in IUU fish⁷. As examples:

- Beginning in 2010, the European Union has required supply certification of wild harvested seafood in order to prevent IUU fisheries products from entering its markets. EC 1005/2008 requires that wild harvested fish entering the EU have a validated catch certificate that can trace the product back to a legally licensed harvest vessel (or group of vessels) in compliance with conservation regulations. Similar legislation is pending in the United States. The U.S. legislation would also require the use of technologies to trace seafood products at each stage of the supply chain – from boat to plate.
- On 17th June 2014, the United States announced that
 - i) all agencies and offices charged with overseeing the seafood supply chain and verifying the authenticity of its products shall implement and enforce relevant policies, regulations, and laws to ensure that seafood sold in the United States is legally caught and accurately labeled.
 - ii) It shall also be the policy of the United States to promote legally and sustainably caught and accurately labeled seafood and to take appropriate actions within existing authorities and budgets to assist foreign nations in building capacity to combat IUU fishing and seafood fraud.
 - ii) the establishment of a presidential task force in Combating Illegal, Unreported, and Unregulated Fishing and Seafood Fraud.

Furthermore, Hong Kong has not signed/ratified or acceded to a number of global agreements which aim to facilitate the sustainable use of shared marine resources, such as ICCAT, NPOA-IUU, Port State Measures.

2. Under the FOOD SAFETY ORDINANCE (CAP 612), food traders are required to keep records but not necessarily submit them unless requested in the event of a contamination incident. Records must be kept of the businesses from which they obtained their food and the business to which they supplied their food.

⁷ The global value of IUU is (US) \$10-23 billion per year.

S22 and S23 of the Ordinance have different requirements. S23. aquatic products only applies to HK Fishing vessels and locally caught aquatic products and this requires records of area of capture. Fish bought in from non-registered vessels comes under imports S22 and there is no provenance requirement.

3. The sustainability status of a lot of seafood imported and sold in Hong Kong has also not been assessed. Environmentally conscious consumers and catering businesses interested in sustainable seafood do not have sufficient information to guide their responsible consumption and purchase.

Strategy and Actions

1. It is recommended that Hong Kong should consider acceding to international RFMO's monitoring and regulation conventions (e.g. ICCAT, CCAMLR), and comprehensively and effectively implement the requisite measures, as a minimum to thoroughly monitor and regulate the trade in certain seafood species (e.g. toothfish, Bluefin tuna).
2. It is recommended that Hong Kong join the increasing global community concerned about traceability as well as IUU and at a minimum adopt Port State Measures in an effort to regulate against IUU fishing and the trade in such fish.
3. Raise awareness of the public about seafood sustainability and initiate project / support initiative to assess sustainability of seafood available in Hong Kong making the information publicly available so consumers can have informed choices, also to businesses to improve their sourcing for sustainable seafood.
4. Hong Kong should assess the feasibility of introducing supply chain traceability requirements in relation to imported seafood. It is further recommended that the provenance requirement under The Food Safety Ordinance S23 also applies to S22 and that data is captured (and not just maintained by traders) in the CSD database of the Hong Kong Government.

B1.2. Other Seafood (Aquaculture) (Excluding Shark / LRFF)

PIC: Allen To, Stan Shea

Hong Kong's Status (role and utilization)

Same as the above in "Other Seafood (Wild Caught) (Excluding Shark / LRFF)"

Areas of Biodiversity Concern/ Impact

Species: Same as the above in "Other Seafood (Wild Caught) (Excluding Shark / LRFF)". Notably, many "farmed" seafood may not come from farming, instead they involve farming of wild caught juvenile fish.

Habitat: Level of impact on habitat varies among seafood cultivation methods, but it basically encompasses a great variety of impact, e.g. habitat destruction to make way for construction of farm, pollution to nearby areas from farm.

Ecosystem: The catching of juveniles for farming purpose (e.g. bluefin tuna), the escape of farmed seafood (e.g. Atlantic salmon), the use of huge volume of small fish / marine life as feed (e.g. bluefin tuna), all have significant impact on the marine ecosystem.

Gaps Identified

The sustainability status of a lot of seafood imported and sold in Hong Kong has not been properly assessed. Environmentally conscious consumers and catering businesses interested in sustainable seafood may not have sufficient information to guide their responsible consumption and purchase.

Strategy and Actions

1. Initiate a project / support an initiative to assess sustainability of seafood available in Hong Kong and make the information publicly available, so consumers can have informed choices, also to businesses to improve their sourcing for sustainable seafood
2. Raise awareness of the public about seafood sustainability

B1.3. Live Reef Food Fish (LRFF)

PIC: Allen To, Stan Shea, Sophie le Clue

Hong Kong's Status (role and utilization)

Based on the Census and Statistics Department dataset and the relevant import data (HK registered fishing vessels), in 2012 (the latest full-year data), > 9,886 tons of LRFF⁸ were imported into Hong Kong. This is likely to be a significant underestimation, since there is no legal requirement to request all fishing vessels importing LRFF into Hong Kong to report species specific trade volumes to the relevant government department.

Hence, the total import of LRFF into Hong Kong is likely to be much larger. This issue is addressed in detail in a report on LRFFT to be submitted to HKIA later this year⁹. Some of the key issues are summarized below (see **Gaps Identified** and **Strategy and Actions**).

⁸ only including groupers, humphead wrasse, other wrasses and parrotfishes, including fry, live

⁹ research is currently being undertaken for HKIA by a collaboration of organisations including Bloom Association, ADM Capital Foundation, WWF, Dr Yvonne Sadovy, CSR Asia and Ocean Recovery Alliance, to review trade volume, source country, trade route, and suggest possible recommendation to improve the regulation in the legal and sustainable trade in LRFF in Hong Kong

Hong Kong has long been known as one of the key consumers and trade hubs of LRFF (Sadovy et al. 2003). Re-export volume of LRFF¹⁰ from HK in 2012 was reported to be about only 70 tons in total (> 0.1% of reported total import). Recent communication with LRFF traders based in Hong Kong indicate that there has been a considerable volume of LRFF entering Hong Kong and subsequently "re-exported" to mainland China that is unrecorded in the Government dataset. Without reliable figures, a clear quantitative understanding on the extent to which LRFF is consumed in Hong Kong and mainland China is not possible, although its importance as regards to global imports remains clear. It has been estimated that Hong Kong accounted for about 60% of the LRFF trade in Southeast Asia (Sadovy et al. 2003).

Notably, it has been documented that as much as 50% of live reef fishes taken out of the water for the trade are immature (WWF n.d.). These fish are either sold directly, or "grown out" in cages until they reach marketable size. This practice is disastrous in the long term when it occurs on a large scale, because caged fish don't contribute to replenishing wild stocks. Also in some places, the spawning aggregations of groupers are targeted, which can easily lead to overfishing of the species in a short time.

A recent legal and policy review on the LRFF trade in the Coral Triangle, from where a significant volume of LRFF in Hong Kong's market is sourced, reported on IUU issue of LRFF. Regarding "Illegality", at various source countries, there are some but very limited national regulations to govern the harvest of LRFF and export of this commodity (e.g. ban on use of cyanide and dynamite for fishing in the Philippines, a licensing system in Malaysia and Indonesia specifically on trade in species targeted in the LRFF, ban on fishing in overfished areas in the Philippines, vessel registration in Papua New Guinea, to name just a few) (Tsamenyi and Palma 2012).

Details of regulation in the Coral Triangle have been reviewed by Tsamenyi & Palma (2012). However it is difficult to estimate the extent to which Hong Kong's import of LRFF is illegally sourced. Regarding "Unregulated", it is generally noted that the LRFF trade is characterized as largely an unregulated fishery within the Coral Triangle. In Hong Kong, for species listed on CITES such as the Humphead Wrasse, there is an existing legal framework to monitor the trade, however its effectiveness has not been assessed. Beyond this, there is no legal framework in Hong Kong to regulate (except for monitoring the import and re-export) the trade in any Threatened LRFF species.

Regarding "Unreported", the LRFF trade has been considered as "one of the greatest but least quantified sources of fishing pressure in the Indo-Pacific region". Within the Coral Triangle, there is a lack of accurate trade information and proper reporting of LRFF trade, and most of the trade data on LRFF within the region comes from Hong Kong authorities, which means that Hong Kong has some of the relatively more complete datasets on the LRFF trade. Despite this, a considerable volume of LRFF entering Hong Kong may not be recorded as Hong Kong registered fishing vessels, which carry LRFF into Hong Kong, do not currently report any of their trade

¹⁰ only includes groupers, humphead wrasse, other wrasses and parrotfishes, including fry, live

volume to the relevant government department when captured in local waters—See ‘Gaps Identified’ below.

In summary, almost all the LRFF are captured unsustainably and some illegally. Up to now, there has not been any LRFF fisheries certified to be sustainable by any third party (e.g. MSC). Via its role as a trading hub and with substantial gaps in regulation, Hong Kong is an important driver of over-exploitation, illegal trade and loss of biodiversity in relation to this trade.

The ongoing research noted above will provide up to date long-term trends of this trade in Hong Kong as well as a detailed review of the legal framework. The recommendations provided below are initial and may be amended with further detail as the study progresses.

Key Areas of Biodiversity concern/ Impact

Species: A study published in 2013 reviewed the global status of all 163 grouper species, it shows that 20 species (12%) are classified as Threatened. These include species traded in the LRFF market in Hong Kong, such as highfin grouper (*Cromileptes altivelis*), Hong Kong grouper (*Epinephelus akaara*), longtooth grouper (*E. bruneus*), giant grouper (*E. lanceolatus*), blacksaddled coral grouper (*Plectropomus laevis*) and squaretail leopard grouper (*P. areolatus*). Other than grouper, another species found in Hong Kong's LRFF market, humphead wrasse (*Cheilinus undulatus*) is an Endangered species (Sadovy et al. 2013).

The same study shows that 22 species (13%) are classified as Near Threatened. These include species traded in the LRFF market in Hong Kong, such as camouflage grouper (*E. polyphekadion*), tiger grouper (*E. fuscoguttatus*) and the leopard coral trout (*P. leopardus*).

Habitat: Harvesting of some species may occasionally utilize methods detrimental to marine habitats, such as cyanide fishing which can kill stony corals, also dynamite fishing which destroy coral reefs.

Ecosystem: The high rates of extraction of reef fish for the LRFF trade are already resulting in fishing down the food chain, with unknown long-term ecosystem impacts.

Gaps Identified

The existing regulatory framework permits the trading of Live Reef Fish Food into and through Hong Kong freely with minimum checks and balances. Specifically:

1. Under **IMPORT AND EXPORT MANIFESTS NOTICE (CAP 60C) AND IMPORT AND EXPORT (REGISTRATION) REGULATIONS (CAP 60E)**, fishing craft registered or licensed in Hong Kong” would fall under the definition of “vessels” in the Ordinance (but are then made exempt from declaration requirements under the Import and Export (Registration) Regulations, exempting their fish “cargo” from declaration. Given the amount of LRFF purportedly brought in by this mode this is a major gap.

“fish caught by local fishing vessels are exempted from making trade declarations in line with the international practice”.

Since fish transport/carrier vessels do not catch fish, the rationale behind the exemption ought not apply to them

2. Under the then **MARINE FISH (MARKETING) ORDINANCE**, the category “marine fish” does not include “live fish”, making a further exemption for locally registered vessels.

Consequently, no inspections of import and re-export declarations are made, making it impossible to assess reliability of declarations or to verify the species declared and there is also a lack of re-export quantity of LRFF from Hong Kong trade across the border to mainland China

3. Under **CAP 586 PROTECTION OF ENDANGERED SPECIES OF ANIMALS AND PLANTS ORDINANCE**, with reference to CITES, the possession license period of validity is considered too long, such that it’s difficult to monitor whether the fishes currently being sold are in fact those against which the license was issued. Therefore monitoring and enforcement of CITES live fish e.g. Humphead Wrasse is problematic.
4. Under the **FOOD SAFETY ORDINANCE (CAP 612)** food traders are required to keep records but not necessarily submit them unless requested in the event of a contamination incident. Records must be kept of the businesses from which they obtained their food and the business to which they supplied their food.

S22 and S23 have different requirements. S23. aquatic products only applies to HK Fishing vessels and locally caught aquatic products and this requires records of area of capture. Fish bought in from non-registered vessels comes under imports S22 and there is no provenance requirement.

This information is crucial to monitoring the LRFF trade, since one of the main aims of monitoring is sustainability of fish stock. The fact that the country of origin is not recorded also seriously impacts the operational strength of the Food Safety Ordinance in terms of source tracing and deterring public health crisis. A more fundamental problem is that this ordinance requires only record keeping, but the information is not handed to another body for compilation or monitoring.

Impacts of this situation:

- a. clearly hinders identifying the major intervention levers upon which tighter regulation / monitoring can be imposed
- b. hinders monitoring of the whole trade in Hong Kong, which is significant due to its large volume and the important role of HK as trade hub

- c. is at odds with the government's own stated intention to use the trade data to compile accurate trade statistics on the basis of which "major decisions on economic policy is taken;
- given the data showing that fishing vessels are potentially an important channel to import LRFF, it therefore cannot be appropriate that such a large inaccuracy exists in trade statistics and;
 - it makes the potential illegal import of CITES species such as the Humphead Wrasse relatively easy. For example, the current possession permit system for selling live humphead wrasse in Hong Kong provides an opportunity for restaurants to sell the fish(es) quickly and re-fill with newly acquired fish without a CITES permit.

Strategy and Actions

1. CAP 586 PROTECTION OF ENDANGERED SPECIES OF ANIMALS AND PLANTS ORDINANCE

It is recommended that the period of validity of the possession license be reflective of the turnover. So in reality shortening the period, as in practice the license issued maybe valid for several years. Note the Director specifies the period of validity of license under S23 of the Ordinance.

2. IMPORT AND EXPORT MANIFESTS NOTICE (CAP 60C) AND IMPORT AND EXPORT (REGISTRATION) REGULATIONS (CAP 60E)

To address the issue of locally registered vessels that are carriers bringing in LRFF from other jurisdictions, it is recommended that:

Fishing vessels be redefined so live reef fish carriers as those that primarily obtain live marine fish from the waters of other countries - therefore are importers and need to make import declarations:-

- a. Amend the classes of vessels (e.g. Class III) to define "live reef fish carriers" [note: there is already a category called "fish carriers"]
- b. Add the definition into the "interpretation" section of the Regulation
- c. Amend the "fishing craft" provision in the Import and Export (Registration) Regulations (Cap 60E) to "not include within that exemption live reef fish carriers meaning those that primarily obtain live marine fish from the water of other countries". [there is a mismatch in terms of use "live reef fish" then "live marine fish" when meaning the same thing]

Apply a weight limit as a means of enforcement. For example, an amount of LRFF over say two tonnes as an example, would almost certainly not have been caught locally and could potentially be used as prosecutorial evidence for non-declaration. Therefore any amount over such a specified weight should theoretically be declared, thus facilitating collection of data on the trade. Expert opinion could potentially be used to prosecute a vessel that does not declare by claiming that fish have been caught locally. This could also be facilitated by requiring the use of VMS (Vessel Monitoring System) for specified vessels.

3. FOOD SAFETY ORDINANCE (CAP 612)

It is recommended that the provenance requirement also applies to S.22. This would then also apply to shark fin. Request that the data is captured and not just maintained by the trader.

4. Addition of species into the Hong Kong Government dining policy

Add additional unsustainable LRFF species into the HK Government official dining policy (along with sharks, black moss and bluefin tuna)

B1.4. Sharks

PIC: Sophie Le Clue, Stan Shea, Tracy Tsang, Andy Cornish

Hong Kong's Status (role and utilization)

There is abundant evidence from peer reviewed research that many shark species and shark populations are in decline. A summary of the population and international conservation status (see Appendix II) indicates numerous elasmobranch species have been found and continue to be found in the Hong Kong shark-fin trade.

In fact, most of the shark fin related trade elasmobranch species are found to experience population declines due to the inadequate management measures, high fishing pressures for trade and illegal fishing. The trade is largely unregulated.

Hong Kong is a major contributor to the decline of shark populations and biodiversity in the ice-free seas of the world, through the local consumption of shark fin, and as a global trade hub for the fin trade, which is composed almost entirely of products from unsustainable sources. The demand for fin is considered to be the biggest driver globally of the decline in shark populations (see Dulvy 2014).

Hong Kong persistently accounts for about 50% of the global shark fin trade and more than half of the chondrichthyans that enter the fin trade are under threat (Dulvy et al 2014).

Although fin import volumes appear to show some decline (19.8% 2011-2012) (34.7% 2012-2013), Hong Kong's share of global imports has remained steady indicating that it remains the global hub for this trade.

Since 1998 total imports have fluctuated, with an average of 9782 MT plus/minus 1,599 MT (s.d.) (excluding canned products). In 2012 and 2013 respectively 8,285 MT and 5390 MT of shark fin related products were imported into Hong Kong (total weight including water content). Of this 2,427MT and 2,000 MT was re-exported meaning that 5,858MT (70%) and 3390MT (63%) stayed in Hong Kong in 2012 and 2013 respectively. Historically (1998 - 2000) around 20% of dried unprocessed shark fin imports appeared to have stayed in HK, this has risen significantly to 60%, 73% and 79% in 2010, 2011 and 2012, respectively

Hong Kong's potential usage (i.e. consumption) is however difficult to determine because of the known practice of stock piling and parallel trading across the China border which has also increased the opportunity for smuggling.

Presently, the only policies or regulations that control the import and export of shark products are those that are enforced under Cap. 586 for species listed on the CITES Appendices. Currently this includes just three species. Five more shark species and two species of Manta ray will be added to CITES Appendix II in September 2014, including species known to be traded in Hong Kong. However, this can hardly address all species of sharks and rays that are threatened with extinction due to overfishing for products that are consumed and traded in Hong Kong (see next section).

The Hong Kong Government is cognizant of the issues surrounding the sustainability of the shark fin trade and in September 2013 it recommended that shark fin should not be consumed at its internal and official functions and that government officials attending events hosted by others should also not consume shark fin.

There are currently no shark products from sustainable fisheries available in Hong Kong (defined as being marketed as such, being accredited as being sustainable by third-party certification, and with traceability systems in place), nor are there likely to be in the near future on any realistic scale that can supply the fin trade.

Areas of Biodiversity Concern/ Impact

Species: A recent study by the IUCN SSC Shark Specialist Group and others (collectively 302 experts from 64 countries), of the conservation status of all 1,041 species of shark, ray and chimera using IUCN Red List criteria, determined that at least one-quarter (24%) are threatened with extinction and well over one-quarter are Near Threatened. Only 37% are predicted to be Least Concern (Dulvey et al 2014). In fact more than half face some elevated risk. Overall it was determined that chondrichthyan extinction risk is substantially higher than for most other vertebrates, and only one-third of species are considered safe. Also refer to Appendix III for details.

The threats are due primarily to overfishing, whether targeted or incidental. Coastal populations of large-bodied species are at most risk, population depletion is most serious in the Indo-Pacific Coral Triangle and Mediterranean (Dulvy et al. 2014).

The occurrence of threatened species in the Hong Kong trade has been confirmed by DNA-testing of shark fin which confirmed that IUCN Red Listed Endangered and Vulnerable species such as Scalloped-, Squat-headed- and Smooth- hammerhead sharks are traded via Hong Kong shark fin auctions. Other Vulnerable species including all 3 thresher species, Shortfin mako, Sandbar and Dusky shark are known to have been traded in Hong Kong.

By far the most abundant species in the Hong Kong shark fin trade is Blue Shark, which is Near Threatened. Fins from other Near Threatened species traded locally include Tiger shark, Silky shark and Bull shark.

Habitat: The impacts of changes in the abundances of shark species to habitats in general are not well known. However, the removal of coastal sharks is believed to indirectly cause changes to living habitats in some cases. As one example, in Shark Bay in Australia, dugongs utilize the seagrass meadows as foraging grounds in the embayment. Data from dive surveys (Wirsing et al. 2007), vessel survey and shark catch survey show that when tiger sharks are scarce, dugongs utilize both shallow and deep habitats; when tiger sharks are common, dugongs tend to reduce foraging rates or favour deeper habitats, which are safer but with impoverished foraging patches. The deeper habitats tend to be overgrazed under the latter scenario. This shift in habitat use by dugongs can lead to marked change in temporal variability in grazing pressure and shape the spatial composition and pattern of the seagrass meadows in Shark Bay. Other examples can be seen in Appendix II

Ecosystem: The loss of sharks on coral reefs can have an impact that propagates down the food chain, potentially contributing to mesopredator release and altering the numbers of primary consumers (Ruppert et al. 2013)

“Removal of top large predatory taxa can create an imbalance between predator and prey abundances and diversity, causing a degraded or negative effect on the dynamics of lower trophic levels or a shift on the entire ecosystems” (Ruppert et al. 2013)

Gaps Identified

1. Despite the widely acknowledged global crisis as regards the decline in shark species /populations and the relatively large proportion of threatened species, only eight species are under any form of trade regulation via CITES, and this remains the Hong Kong Government's only framework for trade regulation.
2. The composition of different shark species traded and consumed in Hong Kong has not been quantified in the last 10 years. Having data on those species threatened with extinction from overfishing would be particularly useful to inform global and regional conservation planning.
3. There are practical difficulties in identifying shark fin (or other shark products) to a species level, although there has been substantial progress in this area globally in the form of guides for unprocessed fins and advances in technology that could be applied locally.

Strategy and Actions

1. There are significant challenges ahead in regulating the fin trade via CITES, not least the reliance on country Non Detriment findings (NDFs) to determine export quotas. There is no agreed methodology for developing NDFs (although guidelines have been developed); there are significant challenges inherent in calculating total shark mortality and the extent to which the trade may influence that mortality; and NDF s are not required to be publically available.
2. These facts lead us to recommend that the HK Government should not allow the import of any CITES Appendix II shark species, unless the NDF is made

publically available by the exporting country. Thus allowing additional scrutiny by the science community.

3. Shark fin trade is the main driving force for shark fisheries (including target fishery or bycatch). As Hong Kong accounts for 50% of the global shark fin trade, a study on the most frequently traded shark species could help in providing more information for CITES parties' further discussion. Based on this study, Hong Kong could propose to list the 5-10 most frequently traded species in Hong Kong on CITES in 2016, which should also be those IUCN "Threatened" species, so that with time what is traded becomes genuinely sustainable. This would significantly help the HK Government with implementation (all shipments would come with paperwork quantifying species and number) or it would be illegal. It is recommended that the HK Government take a leading role in this global issue in which they plays such an important role and join with members of the global community as appropriate, in requesting the listing of the most frequently traded and threatened shark species.

It is understood that the HK Government is undertaking some assessments of the fin trade relevant to CITES species. However a better understanding of the species generally (not restricted to existing CITES species only) traded through Hong Kong is important, given Hong Kong's role as a trade hub and the need to inform government policy looking forward as well as to prepare for future CITES listings.

4. There are 6 Public Cargo Working Areas in Hong Kong. To make the best use of limited enforcement resources, and reduce the possibility of any illegal imports of CITES Appendix II-listed shark species, the government should consider the trading of shark fin be restricted to certain ports. Such restrictive practices have been implemented by other countries, for example, in order to curb illegal, unreported and unregulated (IUU) trade in humphead wrasse, which has been listed in CITES Appendix II since 2004, Indonesia restricts its export to air only (CITES 2010). In Hong Kong, it might be possible to restrict shark fin imports and re-exports to a limited number of designated ports, and at specific times, to facilitate monitoring efforts. This could also apply on any CITES listed species.
5. Separate species level customs codes (Hong Kong Harmonized System code) should be created for the new CITES species (In Sept 2014, authorities will be required to enforce measures for five more shark species placed on CITES Appendix II) and the most frequently traded species. After a period of implementation, the HKSAR government should update if appropriate.

B1.5. Manta and Devil Ray Gill Raker / Gill Plate / Ray Fins **PIC: Stan Shea, Tracy Tsang**

Hong Kong's Status (role and utilization)

The primary threat to *Manta* spp. globally is overfishing driven by international trade to East Asia in their prebranchial appendages or gill plates ("gill rakers") for medicinal purposes (CoP16 Prop. 46). These are the primary manta products in

international trade (Heinrichs et al. 2011, Townsend et al. in prep). The estimated annual global volume of trade is 21,000 kg of dried gills, worth US\$5 million (CoP16 Prop. 46) and representing an estimated 4,652 rays (Heinrichs et al. 2011, Townsend et al. in prep).

This trade is increasing, and is currently unregulated (CoP16 Prop. 46). It is driving increases in targeted manta fisheries in Southeast Asia, India and Eastern Africa. Population declines of 56 – 86% have been documented over six to eight years in areas with targeted fisheries (CoP16 Prop. 46). These concerns led to the two *Manta* spp. being added to App. II of CITES in 2013.

There are considerable volume of rays fins present in the shark fin market. These fins are quite expensive at retail¹¹. Dulvy et al (2014) point out that the reported chondrichthyan catch has been increasingly dominated by rays, which have made up greater than half of reported taxonomically-differentiated landings for the past four decades and that Shark-like rays, especially sawfishes, wedgefishes and guitarfishes, have some of the most valuable fins and are highly threatened.

There seems to be no specific related trade commodity codes documenting the trade of the ray-related gill rakers, especially the most commonly observed dried form. According to CSD, there are codes of 0302 8200 and 0303 8200 which recording the trade products of ray and skates-related products. However, codes including only the forms of fresh and chilled and frozen products which we do not know if they are specific referring for the gill raker products or not. Further, according to the CSD, both commodity codes that developed in 2012 were derived from the previous generic product codes namely of other marine fish, excluding fillets, livers and roes fresh or chilled and other marine fish, excluding fillets, livers and roes, frozen products and so there seems not a possible way of quantifying the demand of ray-related gill raker over past years. Research done by WWF in 2013 showed that there is a potential demand for the dried ray-related gill raker products in Hong Kong and reveals that over 40% of the surveyed shops retailing such products.

Areas of Biodiversity Concern/ Impact

Species: There is no comprehensive study on identifying the species being traded in Hong Kong. However, study shows that at least five members from the family of Mobulidae including the threatened species of *Manta birostris* and *Manta alfredi* found in the global trade.

Habitat: Unknown. Mainly encompassing migratory species

Ecosystem: Unknown. While mantas may be taken as bycatch in many gears, the targeted fishery does not use methods that damage habitats (mainly harpoon or line fishing).

¹¹ According to the market survey conducted by KFBG on Feb 2013 in Sheung Wan. Ray fins was priced at \$148 / catty (600g) for small ones, and \$168 / catty for large ones.

Gaps Identified

The extent of the trade of ray-related gill rakers as well as ray fins in Hong Kong is largely unknown, i.e. traded species, import/re-export volumes and sustainability issues related to the species in the sourcing countries, also local demand for the products is unknown. Further, monitoring on the trade of the dried gill rakers and ray fin trade is generally lacking. As some of the traded species have been listed in the Appendix II recently, it is unsure how the monitoring body would be able to carry out an effective monitoring on the products and enforcement on the illegal trade.

Strategy and Actions

1. Research is needed to understand the trade and consumption of gill raker and gill plate of Manta and Devil Ray as well as fins of other shark-like ray species.. Pilot study conducted by KFBG genetic lab gill raker can be easily identified to species using genetic barcoding method.
2. With the Manta ray becoming CITES II species on September 2014, a field guide to differentiate Manta ray gill rakers should be made available to traders and AFCD CITES enforcement officers.

B2. Timber

PIC: Alistair Monument

Hong Kong's Status (role and utilization)

Superficially, Hong Kong is not a major contributor to global deforestation. Based on trade statistics, Hong Kong's end-usage of timber products has declined since the construction boom of the 1990s and, on a per person basis, is less than in countries which have a similar GDP per person to that of Hong Kong. For example, despite having a GDP just a third lower than of the UK and the Netherlands, Hong Kong's roundwood equivalent (RWE) consumption per person is nearly 70 percent lower than those countries. In terms of trade value, the corresponding total is in the order of HK\$2,500 million. Building and construction works (including temporary works) in the public and private sectors accounts for most of that total. Furniture accounted for approximately 20%, plywood 20%, mouldings and joinery 30%, and sawn wood 10%.

The main environmental concern in Hong Kong regarding timber is not one of quantity but rather the sources of the wood-based products entering end-use. The amount of Forest Stewardship Council (FSC) certified products entering end-use in Hong Kong is increasing but is still relatively low.

Conversely it is estimated that between 20 and 30 percent of the RWE (round-wood equivalent) volume of wood-based products that entered end-use in Hong Kong during 2007 might have comprised illegal timber. This volume is so significant that it makes it probable that consumers in Hong Kong encounter illegal timber in wood-based products every day. It is likely that the majority of illegal timber that enters end-use in Hong Kong is supplied by China, and the remainder made up of plywood supplied direct from Indonesia and Malaysia.

Areas of Biodiversity Concern/ Impact

Species: In the past 25 years alone, 10 percent of the world's forests have disappeared, primarily as a result of human activity. Deforestation is responsible for significant ecosystem and species loss, as well as for around 20 percent of global GHG emissions. Under a business as usual scenario, and in the absence of responsible forest management, deforestation threatens to generate more carbon emissions annually than any other source other than burning fossil fuels.

Habitat: Destruction of forest habitat for timber.

Large-scale destruction of forests and in particular tropical forests for timber production and conversion to plantations has a devastating impact on a large number of plant and animal species. For example, nearly 80 mammal species are found in Malaysia's primary forests. In contrast, disturbed forests have just over 30 mammal species, while oil palm plantations have only 11 or 12 (Wakker 1998). Similar species reductions occur for insects, birds, reptiles and soil microorganisms.

Ecosystem: Deforestation and unsustainable forest management is responsible for significant ecosystem loss.

Gaps identified

There are no regulations that cover the purchase of illegally logged timber and paper products or regulate against unsustainable timber or paper. The EU, USA, Australia all now have comprehensive legislation in place to prevent illegal timber entering their markets. China and other countries in Asia are developing their own regulations to ensure compliance with these new international norms. Hong Kong has not yet developed its own regulations hence making it a potential laundering point for illegal timber, and opening up companies trading through Hong Kong to legal risk when exporting to countries with illegal timber legislation in place.

Strategy and Actions

1. Specify FSC (Forest Stewardship Council) products when purchasing wood or paper products, especially leading by HKSAR government.
2. Encourage responsible purchasing programmes and develop policies that support its implementation.
3. Ensure that all purchases of wood-based products are legally sourced.
4. Develop responsible investment strategies that promote responsible forest management either in forest based investment or in forest products processing or forest products consuming investment.
5. Further develop the building codes of the public sector in Hong Kong to increasingly recognise that, in terms of sustainability, credibly certified timber is

likely to be superior to alternative building materials; while more incentive should give to private sector to use certified timber to gain credit from green building certification in Hong Kong.

6. Advocate that the legality and sustainability of forest management and related commerce and processing should be a particular focus of financial institutions (and their advisers) which facilitates transactions through the Hong Kong stock exchange for businesses which exploit plantations and forests.
7. Facilitate and engage with any negotiations involving the European Union and China concerning any future negotiation of a Voluntary Partnership Agreement concerning the supply of wood-based products under the FLEGT initiative and the European Union Timber Regulation.
8. Demonstrate and educate the importance of responsible forest management, the origin of wood based products and habitats of local vegetation and animal species, to Hong Kong residents by getting a FSC certified forest in Hong Kong to connect Hong Kong consumers with FSC labelled products to the real certified forest.

B3. Paper

PIC: Alistair Monument

Hong Kong's Status (role and utilization)

The pulp, paper and packaging sector accounts for significantly more value than the timber sector, with HK\$27,414 million of imports in 2012 and around 2 million tonnes of pulp and paper products. These numbers have reduced somewhat since the early 2000's but have remained relatively stable in the last few years. As with timber the main biodiversity related significance comes with regards to the source of the material. Forest Stewardship Council (FSC) certified pulp and paper products entering end-use in Hong Kong have increased significantly in the last 5 years, but there are still very significant volumes of pulp and paper being imported from high risk countries for deforestation and degradation such as Indonesia. The majority of this high risk pulp and paper is not FSC certified and may result from illegal logging, tropical forest conversion to plantations or unsustainable management practices.

Areas of Biodiversity Concern/ Impact

Species: A significant amount of the pulp and paper coming into Hong Kong comes from Indonesia where there are major threats to species biodiversity. Deforestation in Indonesia has had a massive environmental impact on the country, home to some of the most biologically diverse forests in the world, ranking third in number of species behind Brazil and the Democratic Republic of Congo. As late as 1900, Indonesia was still a densely forested country: the estimated forest covers of 170 million ha around 1900 decreased to 98 million ha by the end of the 20th century. At

then-current rates it was estimated in 2008 that tropical rainforests in Indonesia would be logged out in another 10 years. The illegal share of all logging is ca 70% in Indonesia. In 2012 Indonesia was losing around the same amount of forest as Brazil annually, despite being only a quarter of the size. Between 1990 and 2010 20% of the forest area in Indonesia had been lost (24 million ha).

Large areas of forest in Indonesia are being lost as native forest is cleared by large multi-national pulp companies and replaced by plantations. Forest are often burned by farmers and plantation owners. Another major source of deforestation is the logging industry, much driven by demand from China and Japan.

Habitat: "Clear-felled of forests (and peat forests) for paper

Large-scale use of tropical forests for pulp production and conversion of tropical forests to pulp plantations has a devastating impact on a large number of plant and animal species. For example, nearly 80 mammal species are found in Malaysia's primary forests. In contrast, disturbed forests have just over 30 mammal species, while oil palm plantations have only 11 or 12 (Wakker 1998). Similar species reductions occur for insects, birds, reptiles and soil microorganisms

"Clear-felled of forests (and peat forests) for timber

Ecosystem: Deforestation and unsustainable forest management for paper production is responsible for significant ecosystem loss

Gap identified

There are no regulations that cover the purchase of illegally logged timber and paper products or regulate against unsustainable timber or paper. The EU, USA, Australia all now have comprehensive legislation in place to prevent illegal timber entering their markets. China and other countries in Asia are developing their own regulations to ensure compliance with these new international norms. Hong Kong has not yet developed its own regulations hence making it a potential laundering point for illegal timber, and opening up companies trading through Hong Kong to legal risk when exporting to countries with illegal timber legislation in place.

Strategy and Actions

Same as above in the recommendations to Timber products

B4. Traditional Chinese medicine (wild)

PIC: Gunter Fischer, Ken Chan, Anastasiya Timoshyna, Yannick Kuehl

Hong Kong's Status (role and utilization)

There is no comprehensive study reporting the trade volume of the species used in TCM. It includes legally as well as illegally imported species for local consumption, as well as TCM that are transited through Hong Kong, where local traders profit from charging intermediary fee. There are many species which fall in IUCN risk categories above "NT" with a large number of species in "DD". Although TCM trade on those

highly threatened CITES Appendix I animals such as rhino and tiger parts are largely non-existent from the market due to strict law enforcement, CITES Appendix II species are still easily available from the markets. For plants species, Hong Kong Customs hold HS statistics record of a list of medicinal plants under the HS heading of 1211. However the species included are largely for facilitating the Health Department to monitor the import of TCM items listed under the Chinese Medicine Ordinance Schedule 1, which concerns only toxic TCM items and have no regards to species of conservation concern. Many of the protected species of Hong Kong, or species relevant to conservation are not included in customs statistics. Formulated TCM (e.g. pill) are regulated by a registration system, some species of conservation concern (e.g. bear bile, musk) are still allowable by law. Due to the lack of information and assessment, many of the medicinal and aromatic plant species that are traded legally or not known to be threatened, their harvest may be in reality unsustainable. On the other hand, many species that are banned for wild harvest in China could be harvested sustainably if properly managed. It represents a missed opportunity for developing a sustainable business model that can benefit collecting communities. Hong Kong, as a major trade hub of TCM with huge purchasing power, should have policy incentive in place to support and promote certified sustainable wild product (e.g. FairWild) in the market.

Areas of Biodiversity Concern/ Impact

Species: A large amount of herbaceous plants but also trees and lianas are used in TCM. It is not possible to list all species in this report but it is important to mention that only for a very small fraction of species with the IUCN extinction risk assessment conducted. Some species such as pangolins are getting so rare in the wild that local species are substituted by African ones. Other species of concern are saiga antelopes, tokay geckos, monitor lizards, snakes (including sea snakes), turtles, mushrooms such as *Ophiocordyceps* or *Ganoderma*, ginseng, orchids (*Dendrobium*, *Flickingeria*, *Gastrodia*, *Gymnadenia*), ferns, *Aquilaria*, pipe fish, sea horses, newts, starfish, sea cucumbers, sea moths, abalones, fish (including marine & freshwater), *Selaginella* and algae. There is a strong concern that many species already have been over-harvested in the wild.

Even for those species appear to be very common in the market, their wild populations are far from being secured. About 200 plant species are widely cultivated for Chinese medicine (Zhao 2001), due to the fact that their wild populations are too depleted to sustain any commercial harvest. It includes liquorice (*Glycyrrhiza* sp.), ginsengs (*Panax ginseng*) and gentian (*Gentiana* sp.). Conservation awareness for these plant species remains low among the general public due to the perceived commonness from the market. These species are listed as the "China State Protected Wild Medicinal Species" together with species as endangered as tiger and saiga antelope (*Saiga tatarica*); collections and trades of the listed species are regulated in China. Nevertheless, illegal wild sourced products are still prevalent in the market. Law enforcement is compromised since illegally collected wildlife can be laundered through captive farm; species identification is confounded by altered appearance after processing, presence of similar congeners and counterfeits. An efficient and accurate identification method is needed to elucidate the species composition and origins involved in the TCM trade. The presence of illegal wild product disrupts the development of business on sustainable

wild harvest. Sustainable wild harvest, if properly managed, presents a huge benefit for collecting communities that rely on wild resource for economic development. Certified sustainable wild product exists largely in European market (e.g. liquorice, oregano and Juniper berry).

Habitat: The impact on habitats is very different between the different types of TCM products. Plant products are often collected in a destructive way by cutting trees or by digging out the whole plant destroying the ecological integrity of the habitat. Animals used in TCM are collected or trapped often using destructive methods.

Ecosystem: Over-harvesting of certain species destroys the food chain in the concerned ecosystem and leads to a destabilization of the ecological integrity. Many of the TCM plants are herbaceous species that are important for the stability of the topsoil. The harvesting of TCM has caused soil erosion and desertification in many part of China, esp. in the northwest such as Xinjiang province. Harvesting of many TCM species are now regulated or prohibited in China for this reason. However, this wild resource if managed sustainably with good harvesting practice and wise use principle, can be beneficial to rural community.

Gaps identified

The IUCN extinction risk status of a lot of TCM products imported and sold in Hong Kong has not been properly assessed. TCM doctors who prescribe mixtures of potentially rare and endangered species as well as pharmacies and particularly consumers may not have sufficient information to guide a responsible purchase and consumption.

The identification of species at the point of import has to be improved to align with international trade monitoring and regulation systems. Application of DNA based identification methods is strongly advised. Other countries like the Netherlands are also using DNA based methods to identify and trace the provenance of species in TCM products. In addition, TCM formula e.g. pills or electuary have been found to contain endangered species but not listed in its ingredient list (Coghlan et al. 2012). Monitoring on TCM formula by the Health Department should extend to test for presence of endangered species. While public awareness to the conservation of TCM animals such as rhino are high; conservation awareness to TCM plant are way far behind. Public education to the public as well as TCM doctors / practitioners is urgently needed.

Many of the TCM consumptions are driven by unproven claims of their health benefits. These claims are highly marketed and persist as a general belief (e.g. turtle shell as cancer prophylaxis). This "blind faith" to TCM is prevalent even among those medical professionals. Hon et al. (2004) surveyed university pharmacy students in Hong Kong, and discovered that 74% of those who used TCM didn't consult a TCM doctor and weren't aware of their side effects. One of the reason may be that, Chinese medicine are usually marketed using non-clinical terminologies (e.g. coldness, hotness, Yin and Yang), which are not regulated as strict as medical drugs.

Strategy and Actions

1. Obtain information from expertise (e.g. universities, TCM pharmacy) in this area, understand which TCM are heavily or widely consumed
2. Initiate project to assess sustainability of TCM available in Hong Kong and make the information publicly available
3. Raise industry and consumer awareness about TCM sustainability
4. Educate the public with basic knowledge of medical principles and practice of TCM; strengthen the regulations on the claims of health benefits of TCM to alleviate wasteful consumption of TCM driven by fraudulent and unproven claims of marketers.
5. Include species of conservation concern into Hong Kong Customs HS statistics for monitoring.
6. Research Needed:
 - a) Compilation of a list of trade TCM species, including information of their course (wild or farmed; geographical location) and trade volume. This list of species is to be used for proposal for new HKHS statistics classification; trial species for sustainability certification, etc. Due to the prevalence of counterfeits and substitutes, the species identities should be verified by DNA barcoding or the protocol of Hong Kong Chinese Materia Medica Standards (HKCMMS).
 - b) Feasibility study on the introduction of sustainable TCM certification system to Hong Kong market. The study should review existing certification systems on wild ingredients (e.g. FairWild); investigate the practical aspects of source-tracing (for both raw materials, and TCM formula), management and ethical standards; propose incentive policies needed from the Hong Kong Government to support the promotion and implementation of the certification systems.
 - c) Identifying gaps in law enforcement in regulating the claims of health benefits of TCM under the Trade Descriptions Ordinance.

B5. Beef

PIC: Idy Wong

Hong Kong's status (role and utilization)

The volume of retained imports of beef in 2010 in Hong Kong exceeded 101,333T [8,317T (fresh beef), 5,541T (chilled beef) and 87,475T of frozen beef] (FHB, n.d.)

Hong Kong is the fifth largest export market in sales of US beef in 2012 (65,000T) (National Cattlemen's Beef Association, 2014).

Past trend of trade: According to the merchandise trade statistics of the Census and Statistics Department on selected items of meat of bovine animals, in 2012 28,317T imports -2419T re-export = 25,898T stayed in HK. Consumption of these selected items has been increasing steady in the last decade, and it increased by 158% in comparison with 2003 (10,031MT)

Beef covered 23% (meat) exports of World Production, that involves 13.1 million MT of meat and 2.0 million MT of hides (WWF Global n.d., c).

Areas of Biodiversity Concern/ Impact

Species: Beef are produced by cattle farming; the species itself is not facing any threat to extinction.

Habitat: The most significant direct impacts of beef production on habitat are the conversion of forest habitat to pasture, the alteration of the composition of native plant communities in grasslands, and the wholesale removal of native vegetation (e.g. forests, scrublands, and grasslands) as habitat is converted to seeded or planted pasture.

The production of feed grains generates significant habitat conversion, soil degradation, water pollution and other environmental impacts.

Livestock farming, including beef production, is one of the main activities responsible for soil erosion around the world.

Ecosystem: Beef production has a considerable effect on global warming due to emissions of greenhouse gases such as methane, nitrous oxide, and carbon dioxide.

Including direct consumption by cattle, irrigation of pastures and crops, and carcass processing, it can take as much as 3,682 litres of water to produce one kilogram of boneless beef in the United States (WWF Global n.d., c).

The expansion of the global cattle industry has been paralleled by the vigorous growth of the beef slaughter and leather industries. Waste from both slaughter houses and tanneries is rich in organic matter and hence poses serious public health concerns if discharged into the environment without appropriate treatment.

Gaps identified

The statutory requirements exercise food safety control and demand food traders to maintain proper records of the movement of food to enhance food traceability. Due to the absence of beef production in Hong Kong, the legal framework does not cover the environmental impacts associated with the production aspects.

Suppliers of sustainable beef production have not been widely identified nor easily accessible by Hong Kong consumers.

Given the global demand for beef has been increasing and beef production has been invading the world's most environmentally sensitive regions, there is an urgent need to reverse the growing trend with respect to the limited carrying capacity of the planet.

Strategy and Actions

1. Education to raise awareness of the consumption impacts of beef and highlight it as a case to illustrate the link between us and biodiversity conservation.
2. Promote sustainable diet and reduce beef consumption.
3. As a significant market of beef, Hong Kong can offer incentive to drive sustainable beef production management practices along the whole supply and creating more sustainable choices for consumers.
4. More research is needed to verify the trade data and look into the supply chain regarding the direct impact of Hong Kong's beef consumption.

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Appendix I: Commodities Reviewed but not prioritized for BSAP 2015 – 2020

Palm Oil

PIC: Idy Wong

Hong Kong's status (role and utilization)

Based on the CSD data of Hong Kong, in 2012, 11,973T imports +28T domestic export – 149T re-export = 11,852T of palm oil and its fractions stayed (consumed) in HK.

Based on the CSD data of Hong Kong, the annual volume of palm oil and its fractions retained (consumed) in HK reduced by 95% from 232,257T (2003) to 11,852T (2012) over the period 2003-2012.

However it is noted that the CSD data is not at all a comprehensive record for palm oil consumption in Hong Kong. Palm oil is used so extensively as a cheap oil alternative for industrial food and chemical productions. As Hong Kong is not an industrial economy, most palm oil is not directly consumed locally, but imported as additive in finished products.

Areas of Biodiversity Concern/ Impact

Species: Large-scale conversion of tropical forests to oil palm plantations has a devastating impact on a large number of plant and animal species. For example, nearly 80 mammal species are found in Malaysia's primary forests. In contrast, disturbed forests have just over 30 mammal species, while oil palm plantations have only 11 or 12 (Wakker 1998). Similar species reductions occur for insects, birds, reptiles and soil microorganisms (Ardiansyah 2006)

Habitat: Clear-felled of forests (and peat forests) for oil palm estates.

Large-scale conversion of tropical forests to oil palm plantations has a devastating impact on a large number of plant and animal species. For example, nearly 80 mammal species are found in Malaysia's primary forests. In contrast, disturbed forests have just over 30 mammal species, while oil palm plantations have only 11 or 12 (Wakker 1998) Similar species reductions occur for insects, birds, reptiles and soil microorganisms (WWF Global n.d.)

Ecosystem: Air pollution - The burning of forests to clear land for oil palm plantations in Indonesia and, to some extent, Malaysia has been cited as the major cause of the air pollution that affected many areas of Southeast Asia in 1997 and 2002, including Singapore and other cities (WWF Global n.d.).

Gap identified

Usage of palm oil and its fraction in to HK is unidentified.

Cause for the declining consumption of palm oil and its fractions in HK, is unidentified.

Accessibility of more sustainable option is unidentified.

Insufficient information for embodied palm oil. This comes from the fact that palm oil is rarely labeled as “palm oil” in product ingredients, but usually as its derivatives such as palmates, or Sodium Laureth Sulfate, or even just as emulsifier. A lot of international campaign and effort are in place to push for a more transparent listing of palm oil in ingredient.

Strategy and Actions

- 1) Using the consumption impact of palm oil as an example in raising awareness about the link between 'us' and 'biodiversity conservation'
- 2) Monitor the global development of sustainable practices for palm oil production, identify and promote awareness of more sustainable options (e.g. certified sustainable palm oil and its products)
- 3) Promote consumers' support to drive conversion to sustainable production.

Sugarcane

PIC: Idy Wong

Hong Kong's status (role and utilization)

Based on CSD statistics of Hong Kong, in 2012, 11,733T imports – 1,465T re-export = 10,268T of cane sugar and chemically pure sucrose stayed (consumed) in HK.

The annual volume of cane sugar and chemically pure sucrose retained (consumed) in HK fluctuated between 118,366T (2008) to 10,268T (2012) over the period 2003-2012.

Globally, the area under cultivation is 19.6 Million ha. Global production is 1,255.8 Million MT sugarcane; 131.96 Million MT sugar (from beet and cane). Its share of world production is 16% (WWF Global n.d, a).

Import to HK is regarded as insignificant in comparison to the global trade on sugarcane.

Areas of Biodiversity Concern/ Impact

Species: Loss of biodiversity as the result of wholesale conversion of habitat on tropical islands and on coastal areas.

Habitat: Sugar has as great an impact on habitat conversion and soil erosion as any other agricultural commodity.

With nearly 20 million hectares in cultivation, sugarcane has more area devoted to it than most cash crops produced in the tropics (WWF Global n.d., a).

Ecosystem: In addition to the impacts from production, wastewater from the mills in washing of all incoming cane (10 cubic meters for each metric ton of cane), from the boiler house used to concentrate the sugar and evaporate the water, and water from cleaning all the equipment (WWF Global n.d., a).

Gap identified

Lack of awareness on this issue

Accessibility of more sustainable option has not be identified

Strategy and Actions

- 1) Using the consumption impact of sugar as an example in raising awareness about the link between 'us' and 'biodiversity conservation'
- 2) Monitor the global development of sustainable practices for sugarcane production and processing, identify and promote awareness of more sustainable options (eg. certified sustainable products)
- 3) Promote consumers' support to drive conversion to sustainable production.

Soy

PIC: Idy Wong

Hong Kong's status (role and utilization)

Soybean imports to Asia are expected to grow from 75 million tonnes in 2009 to 130 million tonnes in 2019 (WWF Global n.d., b).

Approximately 80% of soybean is used for animal feed².

Based on the CSD statistics in Hong Kong, in 2012, 33,147T imports – 10,643T re-export = 22,504T of soy stayed (consumed) in HK.

China is by far the largest importer of soybeans (55 million tonnes) (WWF Global n.d., b).

Notably imports to HK are regarded as insignificant in comparison to the global trade on soy, other analysis for this commodity is therefore not carried out.

Hong Kong's Status (role and utilization)

At the moment no data is available to us on the trade volume of the species and species groups mentioned under column "Species". It is known that many of the species listed, suffer from fraudulent claims of captive-breeding. For particular species, mainly reptiles, the demand and the amount traded is much higher than what can be produced in farms. Some species can't be farmed at all. There is also strong evidence that a lot of orchids used in TCM are harvested in the wild mainly in China's neighbouring countries and are laundered through orchid nurseries. For many species, the trade is not sustainable.

Areas of Biodiversity Concern/ Impact

Species: An increasing number of TCM products are grown or bred in farms. However, there is always a need for "fresh blood" to keep the breeding stock genetically diverse enough to avoid inbreeding and keep the breeding stock healthy. Species or species groups of concern are snakes, turtles, deer, ginseng, orchids (*Dendrobium*, *Flickingeria*, *Gastrodia*, *Gymnadenia*), mushrooms such as *Ganoderma*, abalones and algae.

Habitat: Clearing of land for animal farms.

Ecosystem: Destructive collection methods e.g. felling trees for orchids, significantly disturb the ecosystem.

Gaps identified

The sustainability status of a lot of TCM products imported and sold in Hong Kong has not been properly assessed. TCM doctors who prescribe mixtures of potentially rare and endangered species as well as pharmacies and consumers may not have sufficient information to guide a responsible purchase and consumption.

The identification of species at the point of import has to be improved to align with international trade monitoring and regulation systems. Application of DNA based identification methods is strongly advised. Other countries like the US and the Netherlands are also using DNA based methods to identify and trace the provenance of species in TCM products.

Strategy and Actions

1. Obtain information from expertise (e.g. universities) in this area , understand which TCM are heavily/ widely consumed
2. Raise public awareness about TCM sustainability
3. Research Needed:

1) Market surveys and interview to compile a list of species involved in TCM trade, investigate their source (wild or farmed, or specific geographical location) and trade volume. Due to the prevalence of counterfeits and substitutes, the species identities should be verified by DNA barcoding; or the protocol of Hong Kong Chinese Materia Medica Standards (HKCMMS).

2) Feasibility study on the introduction of sustainable TCM certification system to Hong Kong market. The study should review existing certification systems on farmed ingredients (e.g. Food Alliance Certification, Rainforest Alliance, FairTrade); investigate the practical aspects of farm source-tracing (for both raw materials, and ingredients in TCM formula), management and ethical standards; food-safety.

3) Identifying gaps in law enforcement in regulating the claims of health benefits of TCM under the Trade Descriptions Ordinance.

Biofuels

PIC: Idy Wong

Hong Kong's status (role and utilization)

Based on the CSD data, there is no import and export of biofuel over 2003-2013.

Domestic exports of biofuel in HK only happened in 2010 (146kg) and 2012 (1,360T) over 2003-2012.

Areas of Biodiversity Concern/ Impact

Species: Not identified.

Habitat: Conversion of forests, woodland and wetlands to monoculture plantations for biofuel production (e.g. Projects at Lower Tana River Basin and Dakatcha Woodlands at Kenya).

Ecosystem: An increase in carbon emissions would emanate from destruction of woody and herbaceous plants to make way for biofuel plantation.

Gap identified

Globally recognized sustainable standards and certification scheme for biofuel production is under development.

Strategy and Actions

1. If properly managed and environmental and social standards applied, it is believed that bioenergy can provide diverse alternatives to fossil fuels and contribute to sustainable development

2. Monitor development of sustainable standards and certification scheme for biofuel production
3. Explore application of certified sustainable biofuels in Hong Kong
4. In view of the rapid development in this area, it is proposed to monitor the trends of biofuel import and export in Hong Kong in future years, as well as their origins, production methods, and relevant implication on biodiversity conservation.

Cotton

PIC: Idy Wong

Hong Kong's status (role and utilization)

Based on CSD statistics of Hong Kong, in 2012, 58,605T imports – 24,460T re-export = 34,145T stayed (consumed) in HK. The volume of retained cotton fluctuated between 83,210T (2003) and 11,006T (2011) over the period 2003-2012.

Clothing is one of the main contributors to Hong Kong's household related Ecological Footprint, which account for 12% of the household component (WWF 2013a).

Areas of Biodiversity Concern/ Impact

Species: Documented cases of animals harmed by pesticides applied to cotton fields are many and varied. For example:

1) Fish in Alabama: In 1995, pesticide-contaminated runoff from cotton fields killed at least 240,000 fish in Alabama. Shortly after farmers had applied pesticides containing endosulfan and methyl parathion to cotton fields, heavy rains washed them into the water.

2) Birds in Texas: A breeding colony of laughing gulls near Corpus Christi, Texas, was devastated when methyl parathion was applied to cotton three miles away. More than 100 dead adults were found and 25% of the colony's chicks perished.

Habitat: Not identified.

Ecosystem: Nearly \$2.6 billion worth of pesticides are sprayed on cotton fields each year — accounting for more than 10% of total pesticide use and nearly 25% of insecticides use worldwide

Gaps identified

The status of availability and consumption of organic cotton in Hong Kong is unknown.

Strategy and Actions

1. Raising awareness of the threats of conventional cotton production
2. Use the Ecological Footprint related to clothing to illustrate consumption impact on biodiversity conservation
3. Identify more sustainable options (e.g. organic cotton) and promote consumers' support to drive conversion to sustainable production

Animals and plants wild caught/collected for the food, horticulture, pet and fashion accessories trade.

PIC: Gunter Fischer, Ken Chan

Hong Kong's status (role and utilization)

At the current stage no data is available to us on the trade volume of the species and species groups traded as pets, for horticulture, as art or decoration objects and for fashion accessories. It includes legally as well as illegally imported species. It includes local consumption as well as species transited through HK, which may result in local people profiting.

Areas of Biodiversity Concern/ Impact

Species: Aquarium fish (pet), amphibians (pet, food), birds (pet), ivory (art), Aquilaria (art), precious wood such as ebony or rosewood (art, furniture), orchids (*Paphiopedilum*, *Dendrobium*, *Vanda*, *Aerides*, and many more genera for horticulture), buddha pine (horticulture), shrimps (pet, food), fish (food), pangolin (food), reptiles (pet, food, fashion accessories) in particular snakes (food, pets, fashion accessories) and monitor lizards (food, fashion accessories), occasionally mammals like squirrels & slow loris for the pet trade, ferns (mule's foot ferns and tree ferns for horticulture)

Habitat: Harvesting and catching of some species may utilize methods detrimental to the habitats, such as felling trees, digging out plants, bottom fishing with nets creating a bycatch issue, aggressive trapping methods.

Ecosystem: Processing of animals for the fashion and accessories trade such as python skins or fur of wild animals creates huge amounts of toxic waste which pollutes the environment if not properly treated.

Disrupting the food chain through over-harvesting certain species substantially impacts the ecological integrity of ecosystems.

Gaps identified

The sustainability status of a lot of wildlife products imported and sold in Hong Kong has not been properly assessed. Consumers may not have sufficient information to guide a responsible purchase and consumption. Python skin product is mentioned

here in particular, because of the increasing conservation concern and huge volume of global trade.

The identification of species at the point of import has to be improved to align with international trade monitoring and regulation systems. Application of DNA and isotope based identification methods is strongly advised. Some European countries are also using DNA based methods to identify and trace the provenance of species in the wildlife trade. US law mandates the declaration of species identity of all fish and wildlife products (live or dead; wild- or farm- sourced) for importation and exportation, and all these shipping records are publicly available for trade monitoring purpose.

Baker (2008); Cressey (2013); Gong et al. (2009); Hinsley (2011); Lyons & Natusch (2011)

Strategy and Actions

1. Initiate project / support initiative to assess sustainability of wildlife products available in Hong Kong and make the information publicly available
2. Raise public awareness about the sustainability of wildlife products
3. Strengthen the role of AFCD and Hong Kong Customs in monitoring and book-keeping of all wildlife products (both wild or farmed), not only restricted to CITES-listed species, that are imported to / exported from / transit through Hong Kong ports.
4. Research needed
 - 1) Feasibility study for a stricter port control on wildlife, to mandate accurate declaration of shipments to species level, and employ DNA method to detect fraudulent declarations.
 - 2) Feasibility study of a licensing system for commercial importation and exportation of wildlife products, where license can be revoked for repeated violations of regulations.

Farmed plant and animal trade for food, pets, and fashion accessories.

PIC: Gunter Fischer, Ken Chan

Hong Kong's status (role and utilization)

At the current stage no data is available to us on the trade volume of the species and species groups mentioned under column "Species". It is known that many of the species listed, suffer from fraudulent claims of captive-breeding. For particular species mainly reptiles the demand and the amount traded is much higher than what can be produced in farms. Some species can't be farmed at all. There is also strong evidence that a lot of orchids used in the horticulture trade are poached in the wild

mainly in China's neighbouring countries and are laundered by orchid nurseries. For many species therefore the trade is not sustainable.

Areas of Biodiversity Concern/ Impact

Species: Deer (food, fashion accessories), animal skins & fur (fashion accessories), orchids (horticulture), snakes (food, fashion accessories), turtles (food, pet)

Habitat: Land conversion for large scale farming and the produced farm waste destroy and pollute important habitats.

Ecosystem: Processing of animals for the fashion accessories trade such as python skins or fur of wild animals creates huge amounts of toxic waste which pollutes the environment if not properly filtered.

Gaps identified

The sustainability status of a lot of so called farmed products imported and sold in Hong Kong has not been properly assessed. Consumers may not have sufficient information to guide a responsible purchase and consumption.

Strategy and Actions

1. A certification system is in urgent need to label the products in the market which are sustainably produced. This will support farmers who produce high quality products and help the end consumer to distinguish between sustainable and non-sustainable products
2. Raise public awareness about the sustainability of wildlife products
3. Strengthen the role of AFCD and Hong Kong Customs in monitoring and book-keeping of all wildlife products (both wild or farmed, not restricted to CITES species) that are imported to / exported from / transit through Hong Kong ports
4. Research needed
 - 1) Feasibility study for a stricter port control on wildlife, to mandate accurate declaration of shipments to species level, and employ DNA method to detect fraudulent declarations.
 - 2) Feasibility study of a licensing system for commercial importation and exportation of wildlife products, where license can be revoked for repeated violations of regulations.

Black moss (Fat Choy)
PIC: Karen Lee

Hong Kong's status (role and utilization)

Export and import of black moss in Mainland China is banned since 2000. The Chinese Government has listed black moss as an endangered species (Anonymous 2000). Black moss has been imported from elsewhere, including Canada and the U.S., apart from the Mainland China after the ban.

Black Moss has important historical and cultural values in Hong Kong. Hong Kong does not have export trading of Black Moss. The quantity of re-export of Black Moss is far greater than that of the import of Black Moss.

Past trend of trade: According to the trade data provided from the CSD of Hong Kong, there was no domestic export of the Black Moss in 2003-2012. The import of Black Moss has been stopped since 2006. However, there was approximately four times increase in the amount and value of Black Moss imported to Hong Kong in 2005 compared to that in 2002-2003. Further, there was a continuous decrease in the re-export of Black Moss in 2006-2011 (on average, about 51% decrease). However, the re-export of Black Moss increased by about 41% in 2012 compared to those in 2006-2011. Expected trend of trend: there might be a continuous increase in the re-export of Black Moss in Hong Kong, due to the stored stock of Black Moss in the market.

Areas of Biodiversity Concern/ Impact

Species: No IUCN threatened, or ETP (endangered, threatened, protected) species known.

Export of Black Moss is banned in China. However, illegal digging and trading of Black Moss was reported in China (SCMP 2004).

Habitat: Soil degradation (lead to a lack of cohesion in the soil, and hence, make the soil more vulnerable to water and wind erosion) (BBC 2000; UNEP Year Book 2011)

Ecosystem: Desertification (BBC 2000; UNEP Year Book 2011) - the topsoil and water would be lost after the wild vegetation was lost. The removal of Black Moss caused desert-like conditions to expand miles away.

Gaps identified

Life span of Black Moss and restoration methods to rehabilitate the degraded habitats.

Insufficient trade data regarding to the abundance and origins of import of Black Moss.

Strategy and Actions

1. Education to the general public.
2. Research on the local consumption rate of the Black Moss from the retailers is needed. Further, research on trade data, including volume, source country and trade route of Black Moss should be conducted. Thus, recommendations of the trade regulations could be made (e.g. ban the trade in black moss in Hong Kong) and to ensure sustainable trade of Black Moss in the local regions.

Seaweed

PIC: Karen Lee

Hong Kong's status (role and utilization)

For Seaweed and other algae (HS: 12122100) - import data only available in 2012 (HK\$21,136,784, and 753,411 KG). Data of the domestic export of this item was not available in 2003-2011 and there was no domestic export of the item in 2012. For Seasoned Laver (HS: 20089961) - import data was not available in 2003-2008. However, there was an increasing trend in the import of Seasoned Laver in 2009-2012 (2.65 times in 2012 compared to that in 2009). Further, data of domestic export of the Seasoned Laver was not available in 2003-2008 and there was no domestic export of the item in 2009-2011. The domestic export of Seasoned Laver in 2012 was HK\$12,244 with 102 KG. There was an increasing trend in the re-export of the Seasoned Laver in 2009-2012 (increased by 5 times in 2012 compared to that in 2009). For Other Preparation of Seaweed (HS: 20089969), import data was available in 2009-2012 and there was about 3 times increase in the import of item in 2012 compared to that in 2009. Data of the domestic export of the item was available in 2009-2012. However, there was no domestic export of the item in 2009, 2010 and 2012. Further, the re-export data of the item was available in 2009-2012. The unit price of the re-export of the item was the lowest in 2009 (HK\$50 per KG) while that was the highest in 2011 (HK\$105 per KG).

For Seaweed and other algae (HS: 12122100)- about 83% of the imported Seaweed and other algae were re-exported in 2012.

In general, the unit price of Seasoned Laver (HS: 20089961) and Other Preparation of Seaweed (HS: 20089969) increased in 2009-2012, ranging from HK\$86 per KG to HK\$128 per KG and from HK\$50 per KG to HK\$83 per KG respectively. Trading of the above items would be expected to increase in the coming years.

Areas of Biodiversity Concern/ Impact

Species: No IUCN threatened species, ETP species, or legality issue in its trade identified.

Habitat: Seaweed can protect the coast by dissipating wave energy and turbulence. Further, it captures nutrients. Over-harvesting of seaweed will result in higher wave energy impacting the coast. Further, seaweed provides refuges to small marine

organisms and forms feeding and nursery grounds of marine organisms. Overharvesting of seaweed may result in the loss of feeding and nursery grounds and refuges of marine organisms (Environment and Heritage Service 2007; Natural History Museum n.d.).

Ecosystem: Reduced gene flow (i.e. low effective dispersal and recruitment among populations) (Faugeron et al. 2004). Reduction of abundance of its associated animals (Canadian Science Advisory Secretariat Science Advisory Report 2013/2014 (2013). Disruption of food web as the herbivores (predator) of seaweed will be starved (Hay et al., 1989). Overharvesting may disrupt carbon regulation / cycling (Chung et al. 2013).

Gaps identified

Area of coverage of seaweed in Hong Kong and SE Asia.

Inventory of seaweed culture conditions in Hong Kong.

Inventory of organisms associated with seaweed.

Strategy and Actions

1. Education to the general public;
2. Raise the public's awareness on the sustainability of seaweed harvesting and consumption;
3. A certification system should be set up for production and sale of seaweed in the local markets.
4. Undertake research on the production process, including the culture and collection of seaweeds in the local market should be done. Feasibility study of a licensing system for local commercial production of seaweed products.

Appendix II: Summary of Science based research indicating shark species and population declines

Species	Area (Period of study)	Maximum catch (tonne / year)	Year of the max. catch	Current Stock Status	IUCN status	Reference	Traded name of Shark fin in Hong Kong	IUU	Found in shark fin trade in Europe
<i>Galeorhinus galeus</i> , Tope Shark	California 1930 - 1950	4185	1939	unknown		Ripley 1946			Yes
	Australia 1930 – 2000	3158	1969	84 % decline in mature biomass	Vulnerable	Olsen 1959; Punt & Walker 1998			
	New Zealand 1930 - present	5600	1984	Unknown	Near Threatened	Francis 1998			
	South Africa	249	1992	57 % decline or more in the population, susceptible to overfishing	Vulnerable	Walker et al. 2006			

	Southwest Atlantic	> 5000	Mid 1980s	Over 80 % decline have been noted	Critically Endangered	Walker et al. 2006			
	Mediterranean				Vulnerable				
<i>Lamna nasus</i> , Porbeagle	Northeast Atlantic 1947 – 2000	6000	1947	Decline and subjected to heavy fishing pressure	Vulnerable	Bonfil 1994; Hurley 1998; Stevens et al. 2006			Yes
	Northwest Atlantic 1961 - 2000	9000	1964	Over-exploited, 80 – 90 % decline in population	Vulnerable	Bonfil 1994; Hurley 1998; Stevens et al. 2006			
	Mediterranean				Critically Endangered				
<i>Cetorhinus maximus</i> , Basking Shark	Northeast Atlantic 1946 - 1986	4266	1960	Population declines	Vulnerable	Kunzlic 1988	Tian Jiu Chi	Yes	Yes
	Western Ireland 1947 – 1970s			Over 90 % decline in number of		Fowler et al. 2005			

				catches					
	Mediterranean				Vulnerable				
<i>Squalus acanthias</i> , Piked dogfish	Northeast Pacific 1870 - 2000	53483	1944	Decline in total biomass of 95 % or more	Vulnerable	Ketchen 1986			Yes
	Northwest Pacific (Japan 1952 -1990)			Declined 80 – 90 % in landings	Endangered	Fordham et al. 2006			
	Northwest Atlantic 1960 - 2000	25620	1974	75 % decline in biomass of mature females	Endangered	Rago et al. 1998			
	Northeast Atlantic 1963 - 2000	58000	1963	95 % decline in biomass	Critically Endangered	Ketchen 1986; Fahy & Gleeson 1990			
	Black Sea 1981 - 1992			60 % decline in stocks	Vulnerable	Fordham et al. 2006			
	Mediterranean				Endangered				

					d				
<i>Squatina californica</i> , Pacific angelshark	California 1976 - 1994	590	1985	Almost complete collapse	Near Threatened	Holts 1988; Cailliet 2005			
<i>Carcharhinus longimanus</i> , Oceanic whitetip shark	Gulf of Mexico 1950s – 1990s			99.3 % decline in abundance	Vulnerable	Baum & Myers 2004	Liu Qiu Chi	Yes	
	Northwest Atlantic (1986 – 2000) & Western central Atlantic			Estimated declines of 70 %	Critically Endangered	Baum et al. 2003; Baum et al. 2006			
<i>Carcharhinus falciformis</i> , Silky shark	Gulf of Mexico 1950s – 1990s			91.2 % decline in population; large numbers as bycatch and landed in multi-species shark fisheries	Least Concern	Baum & Myers 2004; Bonfil et al. 2009	Wu Yang Chi	Yes	

<i>Carcharhinus obscurus</i> , Dusky shark	Gulf of Mexico 1950s – 1990s			79.2 % decline in population	Vulnerable	Baum & Myers 2004	Hai Hu Chi	Yes	
	Northwest Atlantic Mid 1970s - present			80 – 85 % decline in abundance	Vulnerable	Fowler et al. 2005; Musick et al. 2009			
	North Carolina 1972 - 2007			99 % or more for decline		Myers et al. 2007			
<i>Sphyrna lewini</i> , Scalloped hammerhead shark	North Carolina 1972 - 2007			98 % decline		Myers et al. 2007			
	Northwest Atlantic 1986 -2000			89 % decline in population	Near Threatened	Kotas 2000; Baum et al. 2003	Chun Chi	Yes	
<i>Sphyrna zygaena</i> , Smooth hammerhead shark	Mediterranean				Vulnerable	Casper et al. 2005			Yes

<i>Sphyrna mokarran</i> , Great hammerhead shark	Northwest Atlantic & Gulf of Mexico 1997 - 2007			At least > 50 % decline	Endangered	Baum et al. 2003; Denham et al. 2007	Gu Pian Chi; Gu Yi Chi	Yes	
	Eastern Atlantic 1973 - 2008			At least 80 % decline in abundance	Critically Endangered				
	Southwest Indian 1978 - 2003			79 % or more decline in catch rate	Endangered				
<i>Carcharodon carcharias</i> , Great white shark	Northwest Atlantic 1986 -2000			79 % decline in abundance estimation	Vulnerable	Fergusson et al. 2000; Baum et al. 2003			
	Mediterranean Sea			Evidence for 50 – 60 % decline in stock	Endangered				
	New South Wales, Australia 1950 - 1999			70 % or more decline		Malcolm et al. 2001; Fergusson et al. 2009			

<i>Galeocerdo cuvier</i> , Tiger shark	Northwest Atlantic 1986 -2000			65 % decline in catch rates	Near Threatened	Simpfendorfer 2000	Ruan Sha	Yes	
	North Carolina 1972 - 2007			Up to 97 % lost		Myers et al. 2007			
<i>Alopias superciliosus</i> , Bigeye thresher	Eastern Central Pacific				Vulnerable	Amorim et al. 2009	Wu Gu Chi	Yes	
	Indo-West Pacific				Vulnerable				
	Northwest Atlantic 1986 -2005			50 - 80 % decline in populations	Endangered	Goldman et al. 2002; Baum et al. 2003; Goldman et al. 2009			
<i>Alopias vulpinus</i> , Thintail thresher				Vulnerable					
	California 1978 - 2000	1087	1982	50 % decline in population		Holts 1988; Goldman et al. 2002			Yes
	North Atlantic				Near Threatened	Goldman et al. 2009			

	Mediterranean				Vulnerable	Goldman et al. 2009			
<i>Prionace glauca</i> , Blue shark	Northwest Atlantic 1986 -2000			60 % or more decline in abundance	Near Threatened	Stevens 2000; Simpfendorfer et al. 2002; Baum et al. 2003	Ya Jian Chi	Yes	Yes
	Tropical Central Pacific			86 % or more decline		Ward & Myers 2005			
	North Pacific 1970s – 1990s			20 % decline in catches		Nakano 1996			
	Mediterranean Sea			Estimated average of 38.5 % decline in catch rates, studies also indicating that huge majority had not yet reached	Vulnerable	Lucio et al. 2002; Megalofonou et al. 2005; Cavanagh & Gibson 2007			

				maturity					
<i>Isurus oxyrinchus</i> , Shortfin mako	Northwest Atlantic 1986 -2000			40 % decline in population	Near Threatened	Stevens 2000; Baum et al. 2003	Qing Lian Chi	Yes	Yes
	Mediterranean				Critically Endangere d	Cailliet et al. 2009			
<i>Isurus paucus</i> , Longfin mako	Northwest Atlantic 1986 -2000			Decline moderately	Vulnerable	Baum et al. 2003; Reardon et al. 2006			
<i>Carcharhinus leucas</i> , Bull shark	North Carolina 1972 - 2007			99 % Decline	Near Threatened	Simpfendorfer & Burgess 2000; Myers et al. 2007	Sha Qing Chi	Yes	
<i>Carcharhinus plumbeus</i> , Sandbar shark	Northwest Atlantic			>/ ≈ 100000 individuals, stock within the US waters started recovering	Near Threatened	Musick et al. 2009	Bai Qing Chi	Yes	

				from overfished after the implementation of management plan in 1993					
	Northwest Pacific				Vulnerable	Musick et al. 2009			
	1972 – 2007 North Carolina			87 % decline		Myers et al. 2007			
	Australia				Close to Vulnerable	Musick et al. 2009			
	Mediterranean				Endangered				
<i>Rhincodon typus</i> , Whale shark	Taiwan			60 -70 % decline in domestic catch	Vulnerable	Chen et al. 1996; Norman 2005	Tian Jiu Chi	Yes	
<i>Rhynchobatus djiddensis</i> , Giant	South Africa 1981 – 2000			Declined in catch rate and number	Vulnerable	Dudley & Cavanagh 2006	Qun Chi	Yes	

guitarfish				of catches					
<i>Rhinobatos hynnicephalus</i> , Ringstraked guitarfish					Near Threatened	Compagno et al. 2006			

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Appendix III: Summary of a literature review on the shark academic researches related to global shark fin trade

Brief findings	Reference	Published year
Population-related		
Based upon data from 1995 to 2010, catch rates of longline fleets declined significantly for blue sharks and mako sharks in the North Pacific and for oceanic whitetip sharks in tropical waters. Median lengths of silky and oceanic whitetip sharks decreased significantly in their core habitat and almost all sampled silky sharks are immature Highlights concerns for sustainable utilization of shark resources particularly for oceanic whitetip and North Pacific blue sharks and the need for more regulation and management of sharks even full implementation of finning prohibition may not substantially reduce mortality rates for these species	Clarke et al. Population trends in Pacific Oceanic sharks and the utility of regulations on shark finning	2012
Quantitative projections of abundance differences on fished versus unfished reefs, based upon the population growth	Hisano et al.	2011

rate estimates, result highlights justify management actions to substantially reduce the fishing mortality of reef sharks and shows that shark species are declining rapidly due to fishing	Population growth rates of reef sharks with and without fishing on the Great Barrier Reef: Robust estimation with multiple models	
Based upon quantitative and qualitative methods of shark sightings for the area, result concludes that the reef shark <i>Carcharhinus galapagensis</i> is locally extinct at St. Paul's Rocks due to high fishing pressure	Luiz & Edwards Extinction of a shark population in the Archipelago of Saint Paul's Rocks (equatorial Atlantic) inferred from the historical record	2011
Documents the relative abundance and composition of reef shark population from 1975 to 2006 declined from a mean of 4.2 individuals in the 1970s to 0.4 individual in 2006 representing a decline of over 90% Highlights the illegal vessels and poaching activities in the remote marine areas	Graham et al. Reef shark declines in remote atolls highlight the need for multi-faceted conservation action	2010
Shows that all known shark fisheries in the southern China region collapsed between the 1970s and the 1990s. Of the 109 shark species present historically in the south China Sea, only 18 species are recorded during the market surveys of which all are landed as bycatch and 65% are	Lam & Sadovy de Mitcheson The sharks of south east Asia – Unknown, unmonitored and unmanaged	2010

found below the size of sexual maturity Markets today are dominated only by smaller species and large shark species are almost all below the size of sexual maturation Emphasis the urgent need for conservation and management plans for sharks in the southern China region		
The importance of marine park and fishery management plan Shows that management zones within the GBR Marine Park are somewhat effective at protecting a portion of the reef shark population from exploitation	Heupel et al. Effects of fishing on tropical reef associated shark populations on the Great Barrier Reef	2009
Deep sea sharks and related species have rates of population increase that are on average less than half those of shelf and pelagic species and include the lowest levels observed to date Population doubling times indicate that once a stock has	Simpfendorfer & Kyne Limited potential to recover from overfishing raises concerns for deep-sea sharks, rays and chimaeras	2009

been depleted, it might take decades and potentially centuries before it will recover Species that occur deepest are those most vulnerable to fishing		
Hammerhead, blue, mackerel and thresher sharks were estimated to be declined between 96 and 99.99% in the Mediterranean Sea between the period of early 19th and mid 20th based upon empirical datasets Illustrates the lack of quantitative population assessments in the Mediterranean Sea	Ferretti et al. Loss of large predatory sharks from the Mediterranean Sea	2008
Porbeagle population has collapsed for second time in the northwest Atlantic since 1960s. Commercial catch rates in 2000s are only 10 – 30% of those catch in the early 1990s, whilst tag recaptures and an age- and sex- structured population model suggest that current biomass is 10 – 20% of that present in the virgin population	Campana et al. The rise and fall (again) of the Porbeagle shark population in the northwest Atlantic	2008

Sharks are found absence or very rare in the abyss region due to the biological and physiological reasons; also estimated through modeling Suggests that all shark populations are within reach of human fisheries and there is no hidden reserve of shark biomass or biodiversity in the deep sea. Therefore, sharks may be more vulnerable to over-exploitation than previously thought	Priede et al. The absence of sharks from abyssal regions of the world's oceans	2006
Using modeling showing historical abundances of many large marine vertebrates were tremendously greater than today, i.e. oceanic whitetip and silky sharks formerly the most commonly caught species have declined by over 99 and 90% respectively between the period of 1950s and 1990s Provides baseline for pelagic sharks in the Gulf of Mexico for generating rational fishery management plan for restoration of the species	Baum & Myers Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico	2004
Rapid declines in large coastal and oceanic shark populations have been shown in the Northwest Atlantic, i.e. Scalloped hammerhead, white and thresher sharks were each estimated to have declined by over 75% in 8 to 15	Baum et al. Collapse and conservation of shark populations in the northwest Atlantic	2003

years time		
Highlighted priority areas for shark conservation and the need of marine reserves		
Catch-related		
Estimate of 100 million sharks were killed globally in 2000 and about 97 million sharks in 2010 with a total range of possible values between 63 and 273 million sharks per year The average exploitation rate ranges between 6.4% and 7.9% of sharks killed per year which exceeds the average rebound rate for many shark populations of averaged 4.9% per year based upon 62 shark species datasets The need for reducing global total shark mortality to rebuild depleted populations and restore marine ecosystems with functional top predators	Worm et al. Global catches, exploitation rates, and rebuilding options for sharks	2013
Indicates that global shark catches are higher than FAO data suggest confirming that there is a need for improved monitoring and reporting on a global scale for the shark	Biery et al. Sharks in the seas around us: How the Sea Around Us project is working to shape our	2011

catch data Emphasis the need for species-specific catch data for most of the shark catching nations Highlights the effects of climate change and ocean acidification on sharks could be substantial with tropical species migrating poleward and into deeper waters	collective understanding of global shark fisheries	
Historical data show that although over 60 shark species were found in the past in local waters, yet only 6 shark species were noted in market surveys. Whitespotted bamboo sharks obtained from Hong Kong local wet markets were mostly small and immature suggesting either that Hong Kong waters are overfished or mature individuals do not stay in shallow coastal waters	Sin, S. Age, growth, and reproductive biology of whitespotted bamboo shark (<i>Chiloscyllium plagiosum</i>) from Hong Kong and adjacent waters (<i>M.Phil. Thesis</i>)	2009
Shows that the official Chile government landing records that only documented four species in the landings, whilst DNA identification of the fins from the fin trade demonstrated that at least 10 shark species are present contrasting to the government record	Sebastian et al. Characterization of the pelagic shark-fin trade in north-central Chile by genetic identification and trader surveys	2008

Species composition of the fins in the north-central Chilean shark fin trade was documented		
Reconstructs Ecuador's mainland shark landings from 1979 to 2004, result illustrates that shark landings are about 3.6 times greater than those reported by FAO from 1991 to 2004	Jacquet et al. In hot soup: Sharks captured in Ecuador's waters	2008
Shark fin-related		
Illustrate the total shark mortality (from both commercial and illegal, unreported and unregulated fishing) appears to be unaccounted for the government official shark catch data in the case of Australian fisheries Results also show that IUU fishing in northern Australia is likely to have detrimental impacts on shark stocks in the region which the illegal fishing for sharks by Indonesian vessels for the year 2006 is between 289.6 and 1071.04 tonnes	Marshall, L. The fin blue line quantifying fishing morality using shark fin morphology (<i>Ph. D. Thesis</i>)	2011
Illustrate the feasibility of using DNA identification to distinguish a specific hammerhead shark according to oceans and thus to estimate the relative contributions of the stocks to fin trade. further, the data could be used to inform	Chapman et al. Tracking the fin trade: genetic stock identification in western Atlantic scalloped hammerhead sharks	2009

stock assessment and management of this hammerhead species	<i>Sphyrna lewini</i>	
Discusses the pros and cons of using Hong Kong shark fin trade data to re-construct the total shark removals in the Atlantic Ocean Emphasis the need of the shark data for RFMO and the importance of Hong Kong's current shark fin trade data	Clarke, S. Use of shark fin trade data to estimate historic total shark removals in the Atlantic Ocean	2008
Estimate of the scale of shark catches worldwide; 26 to 73 million sharks killed per year with median of 38 million Shark biomass in the fin trade is three to four times higher than shark catch figures reported in the FAO global database The trade volumes in numbers of blue sharks are close to or possibly exceeding the maximum sustainable yield levels at the time of study Hong Kong's share of global imports varied between 44%	Clarke et al. Global estimates of shark catches using trade records from commercial markets	2006

and 59% with a mean of 52% over the study period		
Only 14 shark species, from 11 common fin trade categories made up approximately 40% of the auctioned fin weight Auctioned fin weight was dominated by the blue shark, which was 17% of the overall market	Clarke et al. Identification of shark species composition and proportion in the Hong Kong shark fin market based on molecular genetics and trade records	2006
During the 1990s, Hong Kong controlled the majority of unprocessed fin imports, but re-exported them to mainland China for processing Mainland China's fin import figures do not seem to reflect the true quantities of fins in trade At the time of writing, greater involvement of specialist personnel in consignment screening would be necessary to identify products from protected shark species in Hong Kong Customs officials must be given species-specific guidance when screening shipments which could contain products	Shark product trade in Hong Kong and mainland China and implementation of the CITES shark listings	2004

from protected sharks; in the case of Hong Kong, it may be possible to increase in the involvement of protected species officers in the screening process without undue labour demands		
Shark fin imports grew 6% per year between 1991 and 2000, most likely due to the market expansion in mainland China Comparison of Hong Kong fin trade statistics to those of other key trading partners indicates that, in general, Hong Kong;s duty-free status appears to encourage more accurate reporting of trade quantities Under-reporting of the fin trade in the UN FAO databases is found, estimate of world trade through countries trade data is at least twice of the FAO estimates in 1998 - 2000	Clarke, S. Understanding pressures on fishery resources through trade statistics: a pilot study of four products in the Chinese dried seafood market	2004
24 shark fin importing companies	Cheung, G. & Chang, C. Sustainable business versus sustainable environment: A case study of the Hong Kong shark fin business	2003
Extinction risk-related		

Out of the 1041 sharks and shark-related species, one-quarter of the species are threatened according to IUCN Red List criteria due to overfishing Large-bodied, shallow water species are at greatest risk. Overall shark and shark-related species extinction risk is substantially higher than for most other vertebrates and only one-third of species are considered safe Population depletion has occurred throughout the world's ice-free waters but is particularly prevalent in the Indo-Pacific Biodiversity Triangle and Mediterranean Sea	Dulvy et al. Extinction risk and conservation of the world's sharks and rays	2014
Review the effects of shark declines in the ocean by providing examples of top-down effects of sharks have led to changes in some coastal ecosystems, i.e. mesopredator release, changes in abundance, distribution and behaviour of species, but cascading effects are more hypothetical	Ferretti et al. Patterns and ecosystem consequences of shark declines in the ocean	2010
Example of showing the abundances of all 11 great sharks that consume other shark-related species fell over the past 35 years, whilst 12 of 14 of these prey species increased in coastal ecosystems	Myers et al. Cascading effects of the loss of apex predatory sharks from a coastal ocean	2007

Examples of unpredictable impacts of indirect ecosystem effects induced by predator removal from oceanic food webs, i.e. cascaded downward from the cownose ray, whose enhanced predation on bay scallop prey was sufficient to terminate century-long scallop fishery		
Provides example on the declines in large-bodied sharks may affect ecosystems more substantially than previously assumed, i.e. the relationship between green sea turtle and the presence/absence of tiger sharks in Shark Bay, Australia	Heithaus et al. State-dependent risk-taking by green sea turtles mediates top-down effects of tiger shark intimidation in a marine ecosystem	2007
Attempt to predict the collapse and extinction of sensitive species under current levels of fishing mortality Results clearly indicated that to ensure the survival of sensitive species in the northwest Atlantic, fishing mortality has to be reduced by 40 – 80 % Emphasis the need for reductions in fishing effort, bycatch mortality and protection of key areas to initiate recovery of severely depleted communities	Myers & Worm Extinction, survival or recovery of large predatory fishes	2005
Some 50% of the estimated global catch of shark and related species is taken as bycatch that does not appear in official fishery statistics and is almost totally unmanaged	Steven et al. The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the	2000

Fishery modeling programme ECOSIM was applied to estimate the long-term response of ecosystems to fishing on sharks, results included apparent species replacement and shifts in community composition	implications for marine ecosystems	
Miscellaneous		
Emphasis the pelagic sharks and rays of the open ocean are subject to high and often unrestricted levels of mortality from bycatch and targeted fisheries Three-quarters of the oceanic shark and related species are classified as threatened or near threatened Make recommendations to shark and related species fisheries, including implementing and enforcing finning bans and catch limits	You can swim but you can't hide: the global status and conservation of oceanic pelagic sharks and rays	2008
Literature review on IUU shark fishing, regional and national initiatives on addressing IUU shark fishing	Lack, M. & Sant, G. Illegal, unreported and unregulated shark catch: A review of current knowledge and action	2008

Provides a list of shark species that taken in IUU fishing for fin trade		
Application of modeling techniques to illustrate the shark stocks can be harvested sustainably and, if carefully managed, can provide very stable fisheries with criteria of provided critical habitats and the level of catch must be selected carefully Emphasis the importance and need for shark fishery and trade management and left the final comment as follows: there is no question that shark resources can be harvested sustainably; the question is can shark resources be managed sustainably?	Walker, T. Can shark resources be harvested sustainably? A question revisited with a review of shark fisheries	1998

Final Report of the Sustainable Use, Ecological Footprint and Ecosystem Services
Focus Group Submitted to Awareness, Mainstreaming and Sustainability Working
Group of the Biodiversity Strategy and Action Plan (BSAP) Section III – Ecosystem
Services

Title

Understanding of biodiversity and ecosystem services in Hong Kong

Relevant Aichi Biodiversity Targets

Ecosystem Services: T2, T10, T14, T15 and T17

Group leader

CW Cheung

Key experts / stakeholders who were involved in the discussion:

a) Within the Steering Committee/ Working Groups

Mr. C.W. Cheung, Dr. Billy Hau

b) Outside the Steering Committee/ Working Groups

Mr. Alex Chan, Ms. Polly Chik, Dr. S.T. Chiu, Dr. Gunter Fischer, Dr. Kevin Kwok,
Dr. Karen Lee, Dr. Allen To (report coordinator)

Objective

b) to initiate search on ecosystem services provision and relevance to Hong Kong

Scope

Ecosystem Services: Aichi Targets T2, T10, T14, T15 and T17

Identify, and qualify if possible, the ecosystem services provided by different kinds of ecosystems in Hong Kong.

Methodology

Because there is a lack of study in ecosystem services and environmental valuation in Hong Kong therefore the FG attempted an expert-based and literature-based approach to weigh the relative importance of each ecosystem to deliver a certain service. The FG adopts TEEB classification for ecosystem assessment because it is associated with the cost of biodiversity loss and ecosystem degradation. Discussion has been carried out in the first and second meeting. The definition of ecosystem services used in the discussion is shown in Appendix I.

The assessment is based on the group members' knowledge and initial research effort, and is thereby preliminary. The findings of the preliminary assessment are shown in Appendix III. It should not be regarded as an exhaustive reference.

To further justify the relative value, a brief description of how each ecosystem services is relevant to Hong Kong is provided (Appendix I) and how each habitat provides ecosystem services (Appendix II).

Hong Kong's existing status

Currently, there is only limited systematic studies to assess ecosystem service across Hong Kong (e.g. Civic Exchange 2002) but various studies have explored the services for other purposes (e.g. Advice from Professor Nora Tam on mangrove's function to purify water; Water Supplies Department on reservoir capacity; AFCD on the number of visitors to Country Parks, University of British Columbia's socio-economic study on marine fisheries etc.) and there are various experts in ecology and biodiversity in the city.

To ensure the objective to capture benefits of biodiversity and ecosystem services in Hong Kong is achieved, consolidation of the existing relevant studies and garnering expert opinion is therefore the first step which would identify the information gaps, and the need and objectives of further research.

A variety of approaches are available to obtain a general view of the full range of ecosystem services delivered by ecosystems and to assist in monitoring and assessing ecosystem services. Among them, Millennium Ecosystem Assessment (MA 2005) and The Economics of Ecosystems and Biodiversity (TEEB 2013) are the major frameworks. Following definition from Costanza et al. (1997) in including both natural and human-modified ecosystems as sources of ecosystem services and from Daily (1997) in using the term 'services' to encompass both tangible and intangible benefits, MA set out 'to assess the consequences of ecosystem change for human well-being and to establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being.' (MA 2005). TEEB, adapted

from MA, is developed to account for the value and economic benefits of biodiversity including the growing cost of biodiversity loss and ecosystem degradation. TEEB also suggests economic valuation technique for biodiversity and ecosystem services in a range of different contexts. At regional and national scales, other frameworks have also been designed, such as the UK National Ecosystem Assessment (UK NEA). Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) provides a list of case studies of ecosystem assessments undertaken by other sub-global entities (e.g. EU) and countries (e.g. South Africa). After deliberation, the TEEB classification for ecosystem assessment was chosen to define the ecosystem services.

Gaps identified

In general, information available and research focus of most of the ecology and biodiversity studies are related to ecological function and process. Research specifics on ecosystem services (e.g. service generation, spatial and temporal analysis) is still wanting.

In Hong Kong, there is a lack of consolidated study on the status, trends and future trajectories of ecosystems and their service delivery. Sustainability Development Division funded terrestrial habitat mapping and ranking studies (<http://www.susdev.gov.hk/html/en/su/consult.htm>), which provide a glimpse on land cover types in Hong Kong and show the changes over years. The latest report was issued in 2008. No relevant study was conducted since then and the raw data is not accessible to public. Having said that, habitat classification of this report was selected, to capitalize on the preliminary work done so far in this area, and facilitate future work to be continued.

Only limited environmental valuation studies have been carried out (e.g. Jim & Chen, 2009; Brajer et al. 2006; Civic Exchange 2002) but data collected for other purposes (e.g. crop price; construction and maintenance cost of a dam etc) are available for environmental valuation study. Considering that monetary value of nature is merely one of the tools to present value of nature to assist in decision making and is usually assessed along with ecosystem services, the gap can be filled as understanding of ecosystem services progresses (other tools include qualitative measurements such as risk of extinction; and quantitative measurements such as pollutant level, which are of equivalent importance).

Recommended strategy

1. **Understanding baseline** – Ecosystem services and valuation aim to inform decision makers and public with better evidence and knowledge on the value of nature and the benefits the society derives from nature. However, understanding of services provided by Hong Kong's nature is wanting. An ecosystem assessment can be conducted to fill the gap. Once the assessment is made, the authority can set priority and formulate policy response using the assessment as a reference. By setting guidance, direction and definition in the assessment, further studies can then be fostered by wider society (e.g. research institute). It should be noted that the assessment is a consolidated document to serve as a starting point to encourage more studies but not a didactic document to be strictly followed. This stage should be achieved in the 5-year plan.
2. **Collaboration with relevant government departments** – Based on the preliminary assessment, ecosystem services provision is relevant to other government departments (e.g. forest's service on air purification (EPD) and water purification for reservoirs (WSD); vegetation's service on preventing landslide (CEDD); freshwater marsh's/mangrove's service on flood control (DSD) etc). Following the findings from the thorough ecosystem assessment, quantitative, qualitative and (/or) monetary value of biodiversity and nature can then be factored in decision making tools such as cost and benefit analysis, robust-decision making, multi-criteria assessment etc. to formulate policy alternatives. To engage and influence decision makers in all government departments is a long term strategy. With that in mind, continued communication is critical, which should aim to educate different parties to incorporate biodiversity into design, planning and decision making. The authority may employ stage-approach, and engage some government departments first. Then it shall spread across various departments.
3. **AFCD's role** – AFCD should act as a facilitator to facilitate communication and provide a platform for data sharing as appropriate. Funding opportunity should be sought to foster studies of ecosystem services and valuation.
4. **Reporting and accounting** – In the process of developing ecosystem assessment, it should also pave way to future establishment of reporting and accounting systems though it may be more likely to achieve in the next 5-year plan as understanding on ecosystem services and environmental valuation becomes sophisticated. The measurement shall not rely on a single indicator, instead, a suite of measurements, including quantitative, qualitative and monetary, should be developed.
5. **Integration with other focus group findings** – ecosystem services and environmental valuation entail many elements from terrestrial ecosystem to marine ecosystem to sustainable use of resources to traditional knowledge of nature and to policy/decision making. Integration with other WG/FG findings should be sought (e.g. habitat assessment, biodiversity indicators etc.). To stay focused, the ecosystem assessment so suggested should not include any species level assessment at the habitat level.

Recommended actions

It is recommended to initiate an in-depth ecosystem assessment for Hong Kong. An ecosystem assessment is a collective deliberative process to gather data on the status and trends of biodiversity, and its links to human well-being. Expert-driven and literature-driven approach can be employed given that sufficient information is not readily available. In the process, experts (and other stakeholders) review, analyse, and synthesise scientific knowledge, provide baseline and guidelines to disseminate understanding of ecosystem services and its benefits, which in turn facilitate decision making and foster further studies. Communication techniques (e.g. Delphi method) to gather data from respondents of their domain of expertise should ensure free expression of opinions, consensus made and agreed among all parties, and should prevent some participants from dominating others in the process. Figure 1 shows the social process of ecosystem assessment.

Various scopes were tailored by different countries/regions. For instance, UK National Ecosystem Assessment (UKNEA) covers not only evaluation of each ecosystem and drivers of environmental changes in UK, it also covers scenario planning, policy response options, economic valuation, dependence of services outside UK, and summaries the services to the society. It is a nation-wide assessment and engages the experts around the country. Other sub-regions/countries/cities/states initiated a simpler approach by focusing on the status, trends, and drivers of ecosystem change as well as conservation plan (e.g. Canadian Biodiversity). Examples can be sought on IPBES website.

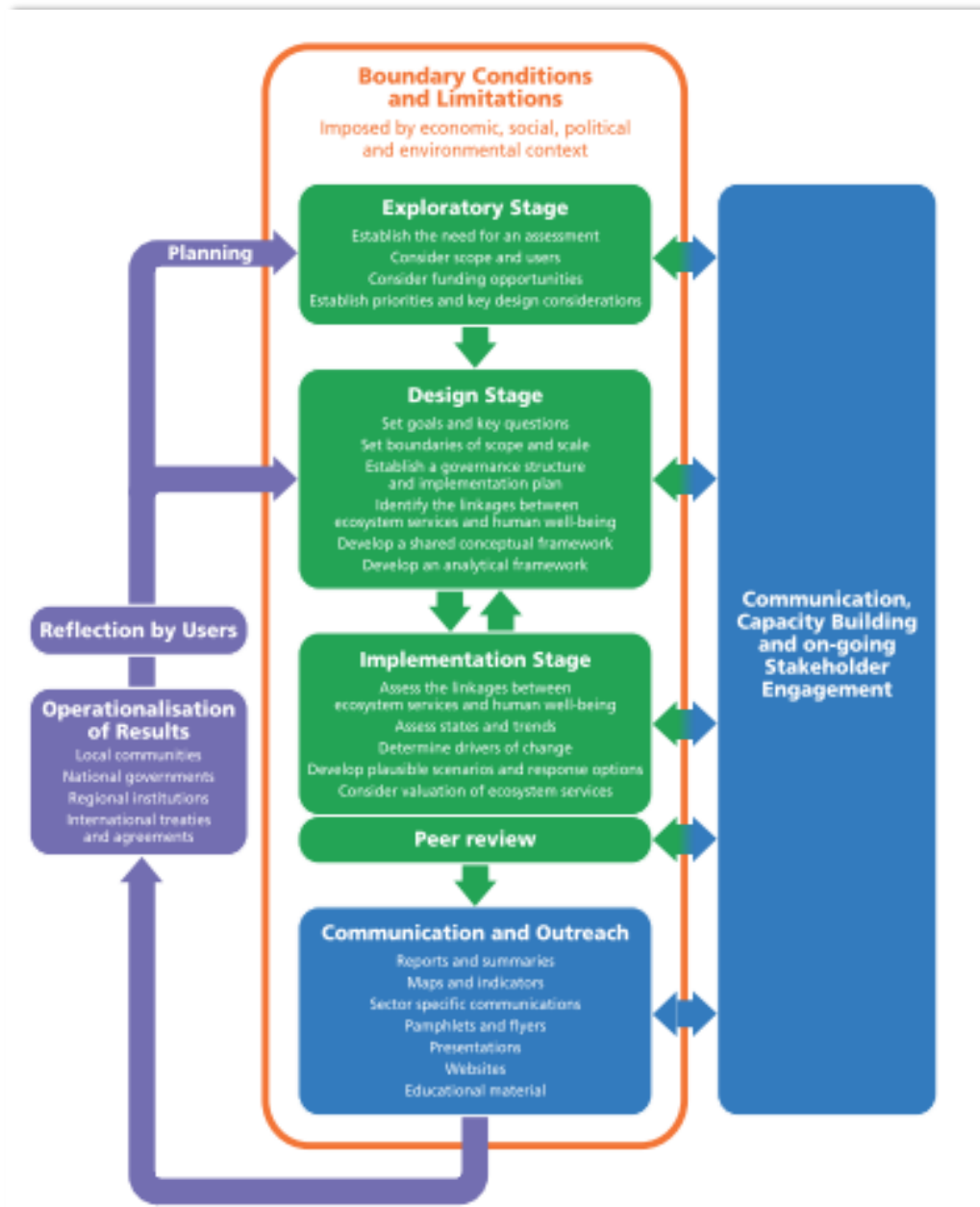


Figure 1. The ecosystem assessment process. (extracted from 'Incorporating biodiversity and ecosystem services values into NBSAPS: Guidance to support NBSAP practitioners' (UNEP-WCMC and IEEP, 2013).)

Nevertheless, the scope of ecosystem assessment is suggested below for consideration:

1. **Significance and priority:** identify significant/priority services and ecosystem in HK.
2. **Temporal and spatial change of ecosystem services:** map various types of ecosystems and their delivery of services; identify current status and predict

changes of ecosystems and their service provision (note: mapping of ecosystem services and their values is a valuable tool for highlighting synergies and trade-offs associated with alternative choices in spatial planning.)

3. **Drivers:** identify both positive and negative drivers causing increase/loss of a particular service over time.
4. **Indicator:** develop qualitative, quantitative and monetary indicators to track performance, monitor consequence of alternative policy options and assist in scientific exploration. (note: for the later steps of environmental accounting and reporting, reference to CICES system can be made because consistent indicators used worldwide would ease comparison through time and across geographic boundary.)
5. **Economic valuation:** use different valuation techniques to measure the monetary terms of the services that will explicitly account for the benefit brought by ecosystem services and loss brought by absence/changes of ecosystem services (note: it can form part of the suite of indicators; and is part of a wider evidence base to provide a full picture of the value of ecosystem services. Since there is only little data available, and economic valuation methodologies have been improving worldwide, key services can be suggested for in-depth study in the first ecosystem assessment.).
6. **Reporting and accounting:** develop indicators to provide detailed statistics for better management; ensure information is up-to-date and is extractable for use. Indicators can be measured regularly to monitor status of ecosystems and services provision. (Note: a framework can be developed in the first ecosystem assessment but not necessarily for implementation because reporting and accounting requires more information. Reporting and accounting, however, shall be put in the second 5-year plan.)
7. **Decision making tool:** develop a suite of tools to integrate ecosystem services information into decision making (e.g. cost and benefit analysis, multi-criteria assessment etc). Given the complexity of the issues, decision making should be made base on the holistic consideration of qualitative, quantitative, monetary indicators and other relevant factors so aroused.
8. **Relevance to other government departments/sectors:** identify the relevance of ecosystem services to different departments/sectors; to encourage different departments to acknowledge ecosystem services and to integrate the services into their planning/decision making.
9. **Further studies:** identify information gap, and suggest further/in-depth studies. Collect feedback from different parties, including decision makers in other government departments, on the type of data needed for decision making.

Expected targets / outcomes

Initiate an ecosystem assessment in the 2015-2020 period.

Implementation (timetable and estimated resources)

AFCD acts as a facilitator.

Set up an expert panel for the ecosystem assessment exercise.

The first ecosystem assessment shall be conducted in the first 5 years to understand the baseline. To avoid complication, the study should preclude any species level assessment.

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Appendix I: Classification and description of ecosystem services adapted from MA and TEEB

Ecosystem Services	Description	Examples and Relevance in HK's Context
Provisioning services - Direct Use, Option value		
Food PIC: Allen To	Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems, but marine and freshwater systems, forests and urban horticulture also provide food for human consumption.	Where: despite the fact that a considerable amount of food we consume in Hong Kong is imported, some of the habitats still have significant ecosystem service in terms of food production. Those very significant contributing habitats include abandoned land used for cultivation, fish ponds, sandy shore, coastal waters and coral areas. Relevance: To name a few examples, sandy shores provide sea urchins, sea cucumbers, bivalves for commercial and recreational purposes; macroalgae (<i>Ulva</i> species) and mollusks are collected from rocky shores; geiwais in Hong Kong provide food (e.g. fish); and fishing and mariculture activities in coastal waters and coral areas are also sources for food. Information Gap: Information especially those related to economic value of the food production service is patchy. While there are pieces of economic value data for coastal fisheries and from fish ponds, there is no information regarding the amount and economic value of food produced by mangroves; revenue generated by clam digging, collecting sea urchins, sea cucumbers (commercial and

		recreational) has not be quantified, the revenue of eco-tourism such as recreational diving activities has not been thoroughly reviewed either.
Water PIC: Allen To	Ecosystems play a vital role in providing cities with drinking water, as they ensure the flow, storage and purification of water. Vegetation and forests influence the quantity of water available locally.	Where: This water provision service is found among a considerable number of habitats in Hong Kong, these include grassland / shrubby grassland, lowland forest, mixed shrubland, abandoned cultivation, modified watercourse, natural watercourse and montane forest. Relevance: all of these vegetation, forest ecosystems and watercourse play crucial roles in providing and ensuring the flow of water. This may be particularly relevant to those vegetation and forest areas around resources on which rainfall are received and channeled to reservoirs for human use. Hong Kong's major drinking water supply depends on precipitation and imported water from Guangdong. Water from these sources is then captured in reservoir; rural area sometimes relies ground water system; HK's flushing water supply comes from sea water. Information Gap: Given the higher than global average per capita water use in Hong Kong, future research would be useful to quantify and value the importance of these habitats in relation to provision of water.
Raw materials PIC: Allen To	Ecosystems provide a great diversity of materials for construction and fuel including	Where: The majority of raw materials used in Hong Kong is either imported or have already

	wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.	been processed into ready-to-use products. Based on the preliminary analysis, only rocky shores in Hong Kong do provide moderately significant raw materials. Relevance: Examples include bio-adhesive from barnacles, byssus from mussels for garments and other purposes, novel chemical compounds from rocky shore microbes for making anti-fouling compounds. However the potential of such use in Hong Kong has rooms for exploration. Information Gap: No major information gap is identified from the preliminary study as this service is not significant in Hong Kong at the moment.
Genetic resources PIC: Allen To	This includes the genes and genetic information used for animal and plant breeding and biotechnology.	Where: From the preliminary analysis, none of the reviewed habitats in Hong Kong is considered to have any significance in terms of providing genetic resources service. Relevance: Not relevant Information Gap: No information gap identified.
Medical resources PIC: Allen To	Biodiverse ecosystems provide many plants used as traditional medicines as well as providing raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.	Where: From the preliminary analysis, none of the reviewed habitats in Hong Kong is considered to have any significance in terms of providing medical resources service. The majority of such materials, if not all, is imported into Hong Kong Relevance: Not relevant Information Gap: No information

		gap identified.
Ornamental resources PIC: Allen To	Animal products, such as skins and shells, and flowers are used as ornaments, although the value of these resources is often culturally determined. This is an example of linkages between the categories of ecosystem services.	Where: from the preliminary analysis, only one habitat, cultivation (abandoned), has been identified to bear any value in ornamental resources for Hong Kong at the moment. Relevance: The wild plants of abandoned cultivated lands are an under-utilised resource for ornamental herbaceous plants and flowering shrubs that could be used in the design of wildlife friendly gardens in man-made landscapes. Information Gap: No information gap identified.
Regulating services – Indirect use, option value		
Air quality PIC: Polly Chik	Trees and green space lower the temperature in cities whilst forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.	Where: Lowland Forest, Mixed Shrubland, Mangrove, Plantation, Montane Forest. Relevance: EPD has identified the two major causes of pollution: emission from motor vehicles, power plants, and industrial/commercial processes; and pollution generated from the region (South China). Strategies have been proposed in terms of reducing emission and collaborating with Guangdong Province. Other relevant issues include urban heat island effect. Green building/infrastructure, estate layout and design and greening principles in urban design have been proposed as mitigation measures. Information Gap: The service

		provided by green space amidst the urban area has been studied. The extent of the service provided by natural ecosystems as well as the association between service provision and biodiversity is not investigated.
Climate regulation PIC: Polly Chik	Ecosystems regulate the global climate by storing greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues; thus acting as carbon stores.	Where: NIL. Relevance: HK Observatory has collected data on climate change in HK (6)¹². Besides, HK has contributed to climate change and has been affected by it; impacts of climate change, strategies to combat and adapt to the impact have been studied. However, given the small area of the city (in the global context), the role of its ecosystems and biodiversity in HK to regulate global climate is less significant. Information Gap: Not identified
Moderation of extreme events PIC: Polly Chik	Ecosystems and living organisms create buffers against natural disasters, thereby preventing or reducing damage from extreme weather events or natural hazards including floods, storms, tsunamis, avalanches and landslides. For example, plants stabilize slopes, while coral reefs and mangroves help protect coastlines from storm damage.	Where: Fishpond / Gei Wai, Intertidal Mudflat, Mangrove, Sandy Shore, Coastal Waters, Coral Areas Relevance: Extreme events frequent in HK are landslide, flood and storm. <u>Landslide prevention:</u> Landslide in HK is mainly triggered by heavy rainfall. Though many of them are minor, severe landslide that caused human death were

¹² HK Observatory (2014). Climate Change. Accessible on http://www.hko.gov.hk/climate_change/climate_change_e.htm

		occasional. A study shows that slopes with thick vegetation are less susceptible to failure in Lantau Island. <u>Flood control:</u> HK faces high flood risks. Flooding occurs in natural flood plains and low-lying areas of the northern part of the NT, older urban area with inadequate drainage system and coastal area during severe weather (e.g. heavy rainstorm). Coastal flood problem is tackled by CEDD for seawall maintenance. Flooding risk is also inter-related to climate change that could cause sea level rise and increased frequency in extreme weather occurrence (e.g. typhoon, storm surge). Information Gap: Landslide prevention: Soil bioengineering, referring to the use of living and non-living plant materials together with civil engineering structures, has been recognized by CEDD as a more advanced measure than engineered stabilization works and direct planting to control landslide on natural terrains. Flood control: DSD has begun to integrate ecological features into drainage channel design/river training works. While mangrove could protect coastline from erosion, its over-expansion may lead to increased flood risk by
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		hydraulic resistance. The effect of ecosystems on natural hazard mitigation is poorly understood and the association of ecosystem change and the subsequent changes in the services is uncertain. Also, the extent of ecosystem services on moderation of extreme events has mostly been replaced by engineered structure in HK before the extent of service provided by nature could be studied.
Water flows PIC: Polly Chik	Drainage & natural irrigation (drought prevention)	Where: Grassland, Lowland Forest, Mixed Shrubland, Cultivation, Modified Watercourse, Intertidal Mudflat, Freshwater/Brackish Wetland, Natural Watercourse, Mangrove Relevance: Water flow depends on water channel that is available, in particular ditches that gone through agricultural area for irrigation. Information Gap: While mangrove could protect coastlines from erosion, its over-expansion may lead to increased flood risk by hydraulic resistance. Small additional change may trigger a disproportionate response in ecosystem's hydrological function. In HK, the most severe change is land use change but the extent of change that might alter hydrological function, in particular ground water table level, is not well studied. In another word, how

		ecosystem could provide water regulation, water flow and water purification
Waste treatment (water purification) PIC: Polly Chik	Ecosystems such as wetlands filter effluents. Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens (disease causing microbes) are eliminated, and the level of nutrients and pollution is reduced.	Where: Grassland, Lowland Forest, Mixed Shrubland, Freshwater/Brackish Wetland, Natural Watercourse, Mangrove, Coastal Water Relevance: Poor water quality can be detrimental to both human and wildlife. Water quality in HK is examined by both WSD and EPD. Whilst WSD is responsible to monitor and treat drinking water, EPD is responsible to monitor beach water quality, river water quality and marine water quality, and to examine the sewerage system. DSD, on the other hand, is responsible for implementation and sewage treatment. Information Gap: Wetland habitat (e.g. mangrove and reed bed) can reduce contaminant level. Some studies suggest that constructed wetland is likely to treat municipal wastewater on site. Small additional change may trigger a disproportionate response in ecosystem's hydrological function. In HK, the most severe change is land use change but the extent of change that might alter hydrological function, in particular ground water table level, is not well studied. In another word, how ecosystem could provide water regulation, water flow and water

		purification
Erosion prevention PIC: Polly Chik	Soil erosion is a key factor in the process of land degradation, desertification and hydroelectric capacity. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture and well-functioning ecosystems supply soil with nutrients required to support plant growth.	Where: Grassland, Lowland Forest, Mixed Shrubland, Intertidal Mudflat, Freshwater/Brackish Wetland, Mangrove, Mangrove, Plantation, Montane Forest Relevance: The importance of ground cover in controlling erosion on the slope has been studied. Information Gap: GLTS has encouraged to plant a mix of native plant species on eroded land as far as practicable to provide protective cover. The extent of services provided by vegetation is not well understood.
Maintenance of soil fertility PIC: Polly Chik	Such as soil formation and nutrient cycling	Where: Grassland, Lowland Forest, Mixed Shrubland, Cultivation, Freshwater/Brackish Wetland, Mangrove, Plantation, Montane Forest Relevance: Soil fertility plays an important role on plant growth in both natural and artificial ecosystem. Poor soil fertility may impede seedling growth and crop growth. To enhance soil fertility, a mix of chemical and organic fertilizer is used for agricultural practice. Information Gap: Information gap not identified at this stage, notably, studies on fertilizer application in agricultural practice has been investigated. Soil fertility's effect on native tree

		seedling growth (together with other factors) has been studied. Hillfire's effect on upland soil fertility has been studied.
Pollination PIC: Polly Chik	Insects and wind pollinate plants which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats.	Where: Lowland Forest, Mixed Shrubland, Cultivation, Mangrove, Fung Shui Forest, Montane Forest Relevance: Pollination is important for vegetation regeneration in both natural and artificial ecosystem. Pollination also supports other ecosystem functions such as tree growth that would deliver other end services (e.g. erosion prevention). Information Gap: Pollination biology was studied in HK and in larger oriental region. Seed dispersal by different mechanisms, in particular by various fauna groups, has been described. Active planting of native species has been recommended to rehabilitate degraded forest on hillsides in HK because native species could attract seed dispersers. On the other hand, seed of some species could be predated and destroyed by animals such as rats and impede forest natural regeneration on degraded hillside. Pollination is important for honey harvest. Extent of pollinator's services in improving crop yield or enhancing biodiversity is not well understood in local system.
Biological control PIC: Polly	Ecosystems are important for regulating pests and vector borne diseases that attack	Where: Lowland Forest, Mixed Shrubland, Mangrove, Fung Shui Forest, Montane Forest

Chik	plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.	Relevance: According to ISSG, 18 out of 45 invasive species (covering from plants, to vertebrate to invertebrate) in HK falls into the list of “100 of the World’s Worst Invasive” (e.g. Mile-a-minute, Golden Apple Snail and Common Myna). Detrimental impact of some invasive species to HK biodiversity has been described. Positive effect of some alien species was also studied. Biological control also implies prey-predator relationship and parasite-host relationship etc. that prevent a given species from turning into a pest status. Information Gap: Status of some invasive species has been studied as a research topic and monitored. AFCD has investigated biological control to repress Mile-a-minute dispersion, which draws no conclusion on the effectiveness and the cost-efficiency though. AFCD has also summarized the common pests and disease in vegetable crops and control measures, which includes biological control. MTR has carried out study on biological control of Apple Snail though the result is not available yet. Effectiveness and risk of biological control for different invasive species is not fully examined. Natural enemy assemblage composition is uncertain.
Habitat services – valued through other ecosystem services		
Maintenance of life-cycle of migratory	Habitats provide everything that an individual plant or animal needs to survive: food,	Where: a number of habitats reviewed offer significant service in this regards, these include

species PIC: Allen To	water, and shelter. Each ecosystem provides different habitats that can be essential for a species' lifecycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their movements.	grassland, lowland forest, mixed shrubland, abandoned cultivation land, fishpond / geiwai, intertidal mudflat, freshwater / brackish wetland, natural watercourse, mangrove, <i>fung shui</i> forests, montane forest and coastal waters. Relevance: a key example of this service is the habitat provided for migratory birds in Hong Kong. Every year tens of thousands of migrating birds come to Hong Kong in winter and they stay in many of the above habitats. This wintering ground is crucial to the life cycle of these migratory species. And these include some of the globally threatened species. A key area is the Mai Po Nature Reserve. Other examples are those anadromous and catadromous fish species found in Hong Kong freshwater habitats. Hong Kong is also used to be an important spawning place for the Chinese bahaba, which used to come close to shoare and spawn within the territorial coastal waters. Green turtle is also another migratory species that would nest in Lamma Island. Information Gap: Information regarding Hong Kong's marine habitats for life-cycle of marine species (e.g. fish) is limited.
Maintenance of genetic diversity PIC: Allen To	Genetic diversity (the variety of genes between, and within, species populations) distinguishes different breeds	Where: From the preliminary assessment, this ecosystem service is provided from an array of habitats, including lowland

	or races from each other, providing the basis for locally well-adapted cultivars and a gene pool for developing commercial crops and livestock. Some habitats have an exceptionally high number of species which makes them more genetically diverse than others and are known as 'biodiversity hotspots'.	forest, mixed shrubland, abandoned cultivation, fishpond / gei wais, intertidal mudflat, freshwater / brackish wetland, natural watercourse, mangrove, fung shui forest, montane forest, seagrass bed and coastal waters and coral areas. Relevance: The above habitats are relatively biodiversity rich, therefore these habitats are genetically diverse and are important to maintain genetic diversity. Hong Kong has a relatively better habitat status / protection, in particular forest, than other areas in southern China that some wildlife populations in Hong Kong may serve precious genetic source. Information Gap: there's a paucity of research regarding the genetic diversity among species populations within Hong Kong and with places adjacent to Hong Kong.
Cultural service – Direct use, indirect use and non-use value		
Aesthetic information PIC: S.T. Chiu	Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, "scenic drives" and the selection of housing locations.	Where: A preliminary assessment indicates this ecosystem service is provided from an array of habitats, including grasslands, lowland forest, mixed shrubland, abandoned cultivation, fishpond / gei wais, intertidal mudflat, bare rock, freshwater / brackish wetland, natural watercourse, mangrove, fung shui forest, montane forest, rocky shore coastal waters and coral areas. Such attributes are especially coveted for the location of

		recreational spaces such as golf courses or for luxury residential developments and dwellings. Relevance: The above habitats are relatively rich, therefore, diverse in terms of the aesthetics qualities which relate to spectacular landscape features, swathes of colours and textures, multi-dimensional layering effects of patterns and forms, the juxtaposition of land and seascapes, the mesmerizing effect of the sights and sounds of nature (e.g., birdsongs or the sound of surf pounding and washing over rocky shores). Information Gap: The Government should explore where there are established techniques and indicators, either qualitative or quantitative in various impact assessment methodologies that can be applied to Hong Kong as a whole.
Opportunities for recreation and tourism PIC: S.T. Chiu	Walking and playing sports in green space is a good form of physical exercise and helps people to relax. The role that green space plays in maintaining mental and physical health is increasingly becoming recognized, despite difficulties of measurement. Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries. In 2008	Where: Most of the natural habitats in Hong Kong offer a significant service in this regard. These include grassland, lowland forest, mixed shrubland, abandoned cultivation land, fishpond / geiwai, bare rock, intertidal mudflat, freshwater / brackish wetland, natural watercourse, mangrove, <i>fung shui</i> forests, montane forest, rocky shore, sandy shore, and coastal waters and coral areas. Relevance: A long list of outdoor recreational pursuits and eco-

	global earnings from tourism summed up to US\$944 billion. Cultural and eco-tourism can also educate people about the importance of biological diversity.	tourism or nature appreciation activities are presented by the ecosystems of Hong Kong: A key example of this service is the natural habitats utilised by residential and migratory birds in Hong Kong which are popular for bird-watching and nature photography. Another example of a habitat that is extensively utilized by the population at large is coastal water which provides opportunities for a wide-ranging list of activities either for pleasure, sport or competition (Dragon Boat Races, Pleasure Boat Excursions, Sailing for pleasure and competition, Canoeing, Windsurfing for pleasure and competition, Water-skiing, Dolphin-watching and Recreational Fishing). Information Gap: The revenue of eco-tourism and other outdoor recreational pursuits should be thoroughly assessed (if not already done) and future research would be useful to quantify and value the relative importance of these habitats in relation to provision of services to recreation and tourism.
Inspiration for culture, art and design PIC: S.T. Chiu	Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.	Where: A preliminary assessment indicates this ecosystem service is provided by an array of habitats, including grasslands, lowland forest, mixed shrubland, abandoned cultivation, fishpond / gei wais, intertidal mudflat, freshwater / brackish wetland, natural

		watercourse, mangrove, fung shui forest, montane forest, rocky shore coastal waters and coral areas. Relevance: However, the potential of such use in Hong Kong has room for greater development. Information Gap: A more comprehensive assessment of the information available and potential for development related to this service could perhaps be much better evaluated with the assistance of the artistic and literary sectors of Hong Kong.
Spiritual experience PIC: S.T. Chiu	In many parts of the world natural features such as specific forests, caves or mountains are considered sacred or have a religious meaning. Nature is a common element of all major religions and traditional knowledge, and associated customs are important for creating a sense of belonging.	Where: A preliminary assessment indicates this ecosystem service is provided by an array of habitats, including grasslands, lowland forest, mixed shrubland, abandoned cultivation, fung shui forest, montane forest and rocky shore. Relevance: This ecosystem service is embedded in the cultural history and traditional folklore as well as local folk belief systems. There is also increasing relevance to New Age practices. : A key example of this service is the natural habitats utilised in the traditional folk belief systems of the placement of shrines to the Earth God (Tu Di Kung); and to the widespread belief that auspicious locations for the graves and tombs for ancestors bring prosperity to the ensuing generations of the local community and the family. At a wider institutional level, the

		“auspicious” fung shui and geomancy aspects of natural habitats and landscapes are carefully considered for the siting and building of temples, monasteries and nunneries, clansmen buildings and ancestral halls. New Age practices which have a strong element of “getting-in-touch-with-nature” and experiential activity make increasing use of natural landscapes (habitats) to invoke a spiritual experience in nature. These usually involved seeking quiet places for undisturbed sessions of meditation (e.g., walking meditation or solo meditation) However, the potential of such use in Hong Kong has much room for greater development. Information Gap: A more comprehensive assessment of the information available and potential for development related to this service could be much better evaluated with the assistance of the local associations that practice traditional folk beliefs and New Age Groups that practice yoga or other traditional meditation lineages in Hong Kong.
Information for cognitive development PIC: S.T. Chiu	Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.	Where: Without exception, every natural habitat in Hong Kong offers a highly significant service in this regard. Relevance: A long list of outdoor education, field studies and

		scientific study are presented by the ecosystems of Hong Kong. These encompass levels of study from kindergarten to postgraduate studies and scientific investigation over a wide range of subjects such as terrestrial and marine ecology, geography, geology, hydrology, drainage and engineering. Furthermore, natural habitats offer services in the form of outdoor training skills such as rock-climbing or mountaineering and especially in competitive sports training (e.g., windsurfing, sailing, sculling, dragon boat rowing) Information Gap: It would be interesting to research, assess and catalogue the home remedies and the uses of medicinal herbs in traditional folk medicine (if this is not already known and reviewed).
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Abbreviation used

EPD – Environmental Protection Department

WSD – Water Supplies Department

CEDD – Civil Engineering and Development Department

DSD – Drainage Services Department

GLTS – Greening Landscape and Tree Management Section

ISSG – Invasive Species Specialist Group

AFCD – Agriculture, Fisheries and Conservation Department

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Appendix II: Brief description on ecosystem services in each habitat in Hong Kong

Grassland / Shrubby grassland (PIC: Gunter Fischer)

Grassland and shrubby grassland account for approximately 16% and 20% of Hong Kong's total land area, respectively. Generally, these habitat types are of low to medium ecological value.

Grasslands are found in areas that were once cultivated but which have since been abandoned, as well as areas subjected to frequent hill fires or heavy grazing by feral cattle. Most grasslands favour species that have a strong ability to regenerate, especially after repeated burning. Grasslands in upland areas might also include bamboo thickets. The largest areas of grasslands are located in the New Territories and on Lantau Island.

Shrubby grassland is defined as land that has more than 50% of its area covered by grasses and the remainder by shrubs. It represents an early stage of natural succession. Establishment of trees by seed in this habitat type is difficult, but improves progressively when fire is prevented. In this habitat type, *Baeckea frutescens* is a common species that grows together with grasses.

Water flows

Grasslands and shrubby grassland in upland areas are important water catchment zones for the provision of clean water and prevention of soil erosion and landslides. Lowland grassland areas are important buffer areas for access water to prevent floodings and soil erosion.

Ornamental resources

A number of showy plants like orchids, rhododendrons or lilies can be found in grassland/shrubby areas, which are of ornamental value.

Habitat services

Upland grasslands in HK are considered secondary vegetation. Centuries of human activities have converted broad-leaved forests into grasslands, which are again slowly converting into forests by natural succession. Although often in the stage of early succession, upland grasslands provide important habitats for rare birds and plants such as grassland orchids.

The ecological value of lowland grasslands is much higher than upland grasslands since in swampy areas grasslands can be considered the climax vegetation, providing an important habitat for many species in particular migratory birds.

Lowland Forest (PIC: Gunter Fischer)

Hong Kong, up to an altitude of 400 m, was originally covered in a very diverse and biodiversity rich (sub)tropical lowland forest dominated by families such as *Euphorbiaceae*, *Burseraceae*, *Clusiaceae*, *Sapotaceae*, *Elaeocarpaceae*, *Moraceae*, *Myrtaceae*, and *Meliaceae*. Because of human disturbance for centuries the original forest cover was completely lost and has been replaced by various successional stages of secondary vegetation.

Young lowland forests are often a mixture of exotic and native (sub)tropical tree species of the genera *Ilex*, *Ficus*, *Macaranga*, *Mallotus*, *Schefflera*, *Schima* and *Machilus*. More mature lowland forest stands in Hong Kong can be very rich in biodiversity with an increased amount of tropical species dominating the canopy such as *Endospermum chinense*, *Artocarpus styracifolius*, *Canarium album*, *Pygeum topengii*, *Gironniera subaequalis*, *Aphananthe cuspidata*, *Bischofia javanica*, *Ficus nervosa*, *Toona fargesii* and *Wrightia laevis*.

Water, water flows and erosion control

Forests play a crucial role in the natural water cycle. The vegetation takes up rainfall, filters and slowly releases it as clean drinking water all year round. The evapotranspiration of forests enhances cloud formation and rainfall. Healthy forests act as a sponge, taking up excess water, which prevents high run offs, soil erosion and landslides protecting streams, rivers and the sea from sedimentation. Once the native forest has been destroyed or replaced by non-native tree species these services can't be guaranteed.

Genetic and medical resources

The more mature the forest the higher the species diversity and the genetic diversity. A high genetic diversity is essential to guarantee a healthy forest in the long run, since species are more resilient to environmental changes. A high genetic diversity is also essential for humans since different genotypes are needed for plant breeding, and other applications in particular in times of climate change, where it will become important to develop new varieties of crops adapted to new climatic conditions such as more rainfall or increased drought. A diverse forest is also an invaluable resource for medicine and other non-timber forest products.

Air quality

Forests sequester carbon dioxide thereby reducing greenhouse gases in the atmosphere and fighting climate change. Fine particles, dust and air borne pollutants are filtered and bound by dense forest vegetation. Trees produce oxygen essential for human survival.

Maintenance of soil fertility

The natural nutrient cycle in the forest maintains the soil fertility. Once the vegetation is removed rain, washes out the nutrients and the soil constantly loses its fertility.

Cultural and amenity services

Forests have a high recreational value, in particular in overcrowded Hong Kong the provision of natural areas is essential for human well-being. Forests are an inspiration for culture, art and design and provide spiritual experience through offering calm and peaceful places in nature.

Mixed Shrubland (PIC: Gunter Fischer)

Mixed shrubland comprises 16% of the total land area in Hong Kong. As grasses occupy less than 50% of the area, a high diversity of shrubs and small trees are represented, providing berries and drupes for wildlife.

Though they are still in an early stage of succession, a significant increase in shrub and small tree density markedly reduces the risk of fire. It would take repeated burning over several years before grassland could become dominant again. Characteristic shrub species include *Polyspora axillaris*, *Rhaphiolepis indica*, *Rhodomyrtus tomentosa*, as well as *Eurya*, *Ilex*, *Litsea* and *Melastoma* species.

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Cultivation (abandoned) (PIC: S.T. Chiu)

About 5% of Hong Kong's land area (1100 sq. km) is land that can be cultivated and these are mostly confined to the narrow alluvial plains of the New Territories. However, the term "Cultivation (abandoned)" refers to lands not under cultivation or abandoned for cultivation.

Food provision

The agricultural land utilisation data as set out in the annual reports of the Agriculture, Fisheries and Conservation Department¹³ shows that Hong Kong has already lost about 60% of its farmland area in the past 50 years; the amount of fresh vegetables produced for consumption (Hong Kong only grows about 2.5% of its vegetables locally¹⁴) as compared with demand is a long way from ensuring food security for the people of Hong Kong; and a Hong Kong scholar has already reported that the present reality of food production in Hong Kong is not desirable¹⁵. We should conserve our remaining agriculture areas to safeguard our capacity and potential for sustainable food production both for the present and into the

¹³ Agriculture and Fisheries Department. 1961. *Annual Departmental Report 1960/61*. Hong Kong Government, Hong Kong.

¹⁴ Agriculture, Fisheries and Conservation Department. 2012. Appendix 2: Fresh food – Production, exports, imports, re-exports and consumption 2009 – 11. *Department Annual Report 2011-2012*. Hong Kong Special Administrative Region Government, Hong Kong.

¹⁵ <http://hk.apple.nextmedia.com/news/art/20130513/18258255>

future; and to protect the livelihoods of those in the rural community of Hong Kong who possess the skills and knowledge, and, wish to continue with farming as a traditional way of life.

Hong Kong is also currently unprepared for the effects of Climate Change and Peak Oil which are likely to be severe. Peak Oil is the tipping point of global oil production which will be followed by an ever-decreasing flow of supply and ever-increasing price hikes, leading to economic and social instability; and is considered by leading analysts to have already arrived. Climate scientists in Hong Kong, Mainland China and elsewhere predict food shortages in the coming years due to climate change in China. Hong Kong's food supply is also heavily reliant on the supply of cheap oil and gas, which is used in the production of fertilizers and pesticides, and of course, which is needed for food transportation and refrigeration. "Food security" is a very serious issue and that the Government should take all possible steps to protect and conserve Hong Kong's active, abandoned and illegally degraded agricultural lands so that there is a chance of Hong Kong having increased resilience in the future. In order to safeguard this important public interest (food supply), the area of agricultural land either under active cultivation or abandoned in Hong Kong should not be further reduced.

Water provision

Water running off the surrounding hills and meandering across alluvial deposits shapes and nourishes the abandoned agricultural land. It provides freshwater for drinking and daily household needs, water for irrigation as abandoned farmlands often occur within a patchwork of land under active cultivation.

Water flows

The flow of water running of hills and meandering across flat land nourishes plant life in the streams, along the banks of streams and rivers and as the water seeps and flows over wet marshland. Fresh water outflows from streams sustain the tidal mangrove community that grows along the coastal fringes. Fresh water flows bring light, space and myriad forms of wildlife into the habitats that are sustained by the flow of water. Water flows at long abandoned cultivated lands at close to the mouths of river valleys sustain pastoral landscapes of wet meadows and marshes and a wide range of aquatic and tidal organisms.

Ornamental resources

The wild plants of abandoned cultivated lands are an under-utilised resource for ornamental herbaceous plants and flowering shrubs that could be used in the design of wildlife friendly gardens in man-made landscapes.

Pollination

The wild flowering plants of abandoned cultivated lands (whether native or exotic) are often important source of food for a myriad variety of insect life that plays a role in the pollination of plants in the surrounding landscape.

Recreation and tourism

Abandoned agricultural land is a huge potential resource for the restoration of sustainable farming practices and for the urban population of Hong Kong who live in dense overcrowded conditions with poor air quality and small household spaces to re-connect with cultivating the earth. There is great potential for recreational activities to escape from the city to pure air, pure thought and outdoor physical activity in Leisure Farms, Garden Farms, Fruit Gardens/Orchards, Agroforestry plots, Herb gardens/farms and LOHAS garden farms

Inspiration for culture, art and design

Cultivating the soil gives us an ideal of existence that is evocative of tending to the land through the process of agriculture or horticulture and respect for the earth (topsoil) from which springs all life. The fertility of soil evokes the higher pleasures of life – a harvest of abundant produce, good food, and, a profound realization of the joy in living through quotations and the flow of words in poetry. Cultivating the soil gives us farms, household gardens and farm plots, community gardens, botanic gardens, temple gardens, medicinal gardens, the quiet satisfaction of Botanical art and the staples of food for the sustenance of human life.

Spiritual experience

A connection and working in tandem with nature through programmes and activities in Organic farming and Farming in Synchrony with the Seasons.

Information for cognitive development

Abandoned cultivated land has potential for scientific study, education and training possibilities, and, recreation. Such endeavors in educational expertise include Horticulture Therapy training facilities, Meditation gardens, Field Studies Centres with demonstration and experimental plots for fruits and vegetables, for horticulture, agriculture and Training centres for Sustainable farming practices such as bee-keeping.

Maintenance of life cycle of migratory species

Abandoned cultivated lands provide food resources and places of shelter for migratory species such as water birds.

Maintenance of genetic diversity

The meadows and wet marshes are lush with wild flowers and the streams run fresh with water from the hillsides sustaining a diversity of lowland aquatic species. The lack of mechanization and development protects the structure of the topsoil teeming with microscopic life and floral diversity that creates a beautiful landscape full of life. The pockets of abandoned cultivated lands make up a unique component of the natural ecosystems of Hong Kong and, hence, hold a reservoir of genetic diversity of wild flora and fauna that exists between the forested hillsides and land under cultivation.

Modified Watercourse (PIC: S.T. Chiu)

In Hong Kong, modified watercourses usually refer to channelised rivers and streams and other water bodies without natural banks and beds, and, without any natural flow pattern (e.g., drainage channels, nullahs and reservoirs)

Water provision

Many upland streams in the natural countryside areas are modified into a network of channels to collect runoff which is diverted into the storage reservoirs dotted around Hong Kong to gather and supply the ever growing and densely packed urban population with their daily water needs.

Water flows

In the lowlands, extensive networks of streams and rivers have been channelized to quickly convey the torrents of water cascading from the steep hillsides as stormwater run-off to prevent flooding. Such concrete-lined man-made structures interfere with the natural hydrology and flow patterns of water running off the surrounding hills by capturing and rapidly directing the water out to sea and reducing bank erosion. However, these structures do not provide a habitat to support a healthy aquatic ecosystem.

Aesthetic

There is much opportunity and potential to improve the aesthetics and functionality of man-made channels and the surrounding landscape by utilising designs that are more wildlife friendly. If done properly, modified watercourses and their immediate riparian zones can even be incorporated as an integral component of garden parks, recreational or open green spaces as well as wildlife corridors (e.g., hedgerow planting) within highly urbanised settings. The implementation of such environmentally-friendly designs would enhance both biodiversity and the site aesthetics of the living environment.

Recreation and tourism

A more sensitive approach to urban landscape and holistic town planning designs could incorporate and integrate modified watercourses into a network of “water gardens” to showcase collecting, purifying and re-circulating clean water using water

plants and reed beds, wet meadows, as components of integrated urban parks (e.g., Parks-on-the-Banks) designed around a watercourse and interconnected as Esplanades for urban dwellers. Such aquatic and terrestrial components in urban spaces bring people out to interact with the natural world and also provide community spaces for all to enjoy recreational pursuits such as walking, jogging, community spaces for informal human contact and activities, e.g., to do “morning exercises” or Tai Chi in more pleasant surroundings of landscaped banks, paddling pools and water play-areas, tranquil ponds and picturesque man-made lakes in place of the current blight of functional grey concrete and engineered water channels.

Inspiration for culture, art and design

There is much potential for better practices in environmental design and performance to harvest rainwater and integrate the drains, channels and nullahs with the surrounding environment in a holistic way to transform such areas into community spaces and Water Gardens. Such new spaces would provide an opportunity for the community to get closer to the water and to enable them to appreciate and come to cherish the value of water resources.

Spiritual experience

Such recreational and community spaces bring people closer to water, establish a connection with water and evoke a deeper understanding of life-giving functions of water.

Information for cognitive development

Such man-made modifications and engineering of natural features (watercourses) of the landscape provide for a wide range of urban landscape and town planning studies for better river basin ecological enhancement and management studies, wetland creation and research field studies facilities, conservation of healthy landscapes, rainwater harvesting and the integration of “water gardens” into landscape designs for a better quality of urban living environment and which would also benefit wildlife.

Fishpond / Gei Wai (PIC: Kevin Kwok)

Recent consultant work for the Hong Kong government defines fish pond as “small artificial lakes that have been constructed for the purposes of growing freshwater fish” and gei wai as “small artificial lakes which contain brackish water and are often flushed through tidal action” (Susdev 2008). Total area of these shores was found increased slightly from 896 ha to 1008 ha between 2007 and 2008 and the change was due to change in survey methodology (Susdev 2008). The most recent report on total area of fish ponds is 1 130 ha and are located mainly in the north-western New Territories. The majority of fish farms are engaged in carp polyculture (bighead carp, silver carp, common carp and grass carp) in

combination with tilapia or grey mullet. Total fish pond production in 2012 amounted to 2 306 tonnes, valued at \$57 million (AFCD 2014).

Both fish pond and gei wai are classified as medium value ecological habitat in Susdev report (2008).

Food provision

This habitat category is mainly used to food provision purpose. It can be used to provide food to both humans and to animals (e.g. geiwais in Mai Po produce invertebrates for migratory birds).

Maintenance of soil fertility

Wastes (especially nitrogenous waste) from food species cultured in fish pond and gei wai make the bottom sediment very fertile. The potential use of these sediments for helping crop growing is being investigated in many countries. In some countries like Thailand, shrimp-rice growing rotation is practiced to exploit the fertile soil after growing shrimp.

Intertidal Mudflat (PIC: Karen Lee)

Intertidal mudflat is a transitional area between aquatic and terrestrial environments with muddy substratum. Many processes, including predation and nutrient cycling, on/ in the mudflats are influenced by tide. The sediment generally consists of silts and clays with high organic content. The total area of intertidal mudflat was estimated as 745.7 ha (0.67% of the total habitats mapped in 2007) (Susdev 2008). Largest area of intertidal mudflat occurred along the Deep Bay shoreline in the northern part of the New Territories. The intertidal mudflats, together with the fishponds and mangroves, form the basis of Mai Po Ramsar site.

The mudflats support abundant invertebrate and fish populations, which in turn attract wintering and migrating birds (DSD 2002). The mudflats in the northern New Territories are also likely to be an important summer feeding ground for herons and egrets, such as Little Egret (*Egretta garzetta*), Chinese Pond Heron (*Ardeola bacchus*) and the established egretty (e.g. HyD 2002a; HyD 2002b; Anon 2012).

Food provision

Oyster culture has been practiced in Hong Kong for about 200 years. Most of them are located in the inter-tidal mudflat of Deep Bay and Lau Fau Shan in the northwest New Territories. Most of Hong Kong's oyster farms make use of the method of seabed culture. However, in recent years, some oyster farmers turned to fattening of medium size oysters imported from the Mainland. Majority of them adopt the raft culture method in which oysters were placed in baskets suspended from rafts.

In 2012, the product yield was about 92 tonnes (excluding shell) and valued at HK\$7 million (AFCD 2013b). Further, some people dig calms for commercial and recreational purposes (e.g. in Tung Chung Bay and Shui Hau at Lantau Island, Skypost 2013). However, the revenue generated by clam digging has yet determined.

Moderation of extreme events

The accumulation of sediment on mudflats has important implication on the sea level rise. If the channels are relatively deep compared to the tidal prism, sediment accumulation is likely to occur (Inge et al. 2013).

Water flows

Intertidal mudflat acts as a sink of nutrients. Nutrient fluxes at the sediment-water interface can hence, influence the nutrient composition of the water column. It is because the sediment on the mudflat can act as a sink or a source of various materials, such as inorganic nitrogen and carbon through different biogeochemical processes (Lee 2000). Further, incised channels inside the intertidal mudflats play an important role in sediment and nutrient transport (Rinehimer et al. 2012). The long-term implication of the low tide discharge from mudflats may be significant in setting the morphology of the shore.

Erosion prevention

The intertidal mudflats, together with the associated mangroves serve to prevent soil erosion. In general, only the top layer of sediments of the intertidal mudflats is removed by the tide/ wave action. The mudflats also act as a buffer against the fluctuations in salinity, pH and temperature and hence, provide a relatively stable environment for the associated plants and animals (Feuillet-Girard et al. 1997).

Aesthetic value

For recreational purposes (e.g. clam digging).

Habitat services

The intertidal mudflat at Mai Po Ramsar Site supports a high diversity of birds. Further, it serves as an important feeding and resting ground for wintering and migratory birds, including a number of globally threatened species (e.g. Black-faced Spoonbill, Saunders's Gull and Imperial Eagle) (AFCD 2013b). Further, there is a vast benthic invertebrate diversity in the mudflat. The mud-dwelling worms (Oligochaeta and Polychaeta) and shells (Gastropoda and Bivalvia) are the main food for shorebirds (or waders). Besides, the mudflat is also utilized by mudskippers and crabs, which are important food items for waterbirds such as egrets and herons (Shen et al. 2006).

Bare Rock or Soil (PIC: S.T. Chiu)

About 85 % of the land area of Hong Kong is underlain by volcanic and plutonic rocks. The volcanic rocks are mostly a variety of larval tuffs and pyroclastic rock types. Granitic rocks are also widespread throughout Hong Kong. Within the last 2 millennia, weathering has exposed many of these rock formations and the remnant soil in the undeveloped, hilly areas are acidic, and low in nutrients and organic matter especially in areas denuded of vegetation by anthropogenic deforestation.. The process of weathering has also lead to the deposition of locally thick superficial deposits of colluvium and alluvium especially along the major river valleys. Bare rock or soil is generally taken to mean naturally open rock faces or disturbed lands, or “badlands” denuded of vegetation.

Such areas are subject to Xerosere succession (primary succession, secondary succession), and the processes of weathering and erosion (rocks to soil). The stages of ecological development on the bare rock surfaces are mainly limited to colonisation by autotrophic organisms, e.g., lichen or moss.

Recreation and tourism

The variety of rock types and accessibility has enable Hong Kong to designate about 50 sq. km of land as the Hong Kong Global Geopark of China. The unique landforms and formations of the igneous and sedimentary rock shaped by waves and weathering draw increasing numbers of visitors both local and overseas to visit and admire such areas. These natural geological formations lend themselves to recreational activities such as nature photography of rockscapes. The large numbers of visitors to these areas facilitates the socio-economic development of supporting tourist infrastructure and provision of services in transport, catering and lodgings.

Spiritual experience

The spectacular natural rock formations provide inspiration for artistic expression by way of rock carvings, calligraphy, poetry; and “cultivating the earth” through the use of rocks, boulders, pebbles and sand in garden, parks and landscape designs (e.g., Japanese sand and rock gardens).

Information for cognitive development

Rocky landscapes and bare soil provide rich ground for the scientific and field studies in such areas as geology, archaeology and earth sciences.

Freshwater / Brackish Wetland (PIC: Kevin Kwok)

Recent consultant work for the Hong Kong government defines freshwater and brackish wetlands as “lands covered with

shallow waters and dominated by emergent hydrophytes (i.e. reedbed)” (Susdev 2008). Total area of these wetlands was found to have decreased significantly from 897 ha to 498 ha between 2007 and 2008 but no reason was suggested (Susdev 2008). They are classified as High value ecological habitat (Susdev 2008) and are scattered with a few larger sites at northwest and northeast Hong Kong.

Recreation and tourism

Local and foreign bird watchers come to Hong Kong for bird watching. Freshwater/brackish wetland such as Luk Keng and Long Valley are some recommended locations for bird watching by Bird Watching Society and have diverse bird fauna and locally rare species (e.g. Greater Painted Snipe). Luk Keng is also an important site for dragonfly watching.

Water flow regulation, waste treatment

Freshwater and brackish wetlands regulate water flow by mostly slowing flow down and providing storage capacity. The slow flow allows water to trap sediment and biological (microbial) breakdown of pollutants to take place. Wetlands also have the potential to slow down and absorb water during floods.

Erosion prevention

These wetlands slow down water flow and in turn lessen erosion.

Food provision

Food organisms such as clam *Ruditapes* spp. can be found in brackish wetland. Wetland agriculture, i.e. turning wetland into farmland, is also a common practice from some parts of the world (Krecek and Haigh 2006).

Maintenance of soil fertility

Streams and rivers leach nutrients upstream and deposit at wetlands (Krecek and Haigh 2006).

Natural Watercourse (PIC: S.T. Chiu)

Natural watercourses are rivers and streams experiencing natural flow patterns in unchannelised bed and banks. These streams exhibit seasonality in their flow patterns and those on the steep hillsides can become raging torrents during summer washing down, boulders, stones and soil during heavy rainfall and storms. On the lowlands, the continuous flow of water running off hills and meandering across flatter land nourishes plant life in the streams, along the banks of streams and rivers and as the water seeps and flows over wet marshland and tidal communities.

In the lowlands, natural watercourses are an especially important habitat of about 590 ha covering just 0.5% of the land area in Hong Kong. These lowland habitats are subject to unrelenting threats from development.

Water provision

The Hong Kong landscape has been settled for many millennia such that people living in the countryside have always relied upon gathering the water running off the hills. In the many pockets of rural or the more isolated communities, small dams and wiers were built across steep hillside streams to create a stable water storage and supply system for the daily needs of villagers as well as irrigation water for the cultivation of their fields.

In the last 2 centuries, the network of natural watercourses in upland areas have been extensively tapped for abstraction of freshwater for storage in reservoirs dotted around Hong Kong's hills to supply the ever growing and densely packed urban population with their daily water needs.

Water flows

The flow of water running of hills and meandering across the landscape nourishes plant life in the streams, along the banks of streams and rivers, and, as the water seeps and flows over soggy marshland in the lower reaches of the riverine system. Fresh water outflows from streams sustain the tidal mangrove communities that grow along the coastal fringes. Fresh water flows bring light, space and myriad forms of wildlife into the habitats that are sustained by the flow of water. Water flowing into the mouths of river valleys sustains pastoral landscapes of wet meadows and marshes and a wide range of aquatic and tidal organisms.

The hydrology of water flows across the landscape sustains a mosaic of habitats and wilderness areas.

Waste treatment (water purification)

The micro-organisms of aquatic habitats and the large variety of aquatic plants in their myriad forms (floating, submerged, emergent, riparian, tidal, microscopic or otherwise) cleanse water naturally.

Aesthetic

The beauty of cascading waterfalls, ripples across still waters, the morning mists hanging over the surface of slow flowing waters, mists and spray formed by water tumbling over rocks, meandering river flows – all shapes and the myriad phenomena of water have a timeless appeal that beckons to the senses.

Recreation and tourism

The natural features of water courses (flow of water, meandering course, waterfalls and rapids, pools, riverine avenues of trees lining the banks of streams, the flitting of dragonflies over water) with its variety of plant life and wildlife lend these habitats to a wide range of nature appreciation activity and nature photography.

Inspiration for culture, art and design

Watery landscapes evoke our physical and cultural connection to the land and air. Watery landscapes are seemingly fluid changing with the light and mood. Paintings, sculpture and statuary, poetry and quotes become expressions that try to reflect the timelessness of the flows of water through land, places as it touches the lives of people.

Spiritual experience

Natural watercourses provide many opportunities for “In-touch-with-nature” Experiential activity, (e.g., Senses Soothing effects of the sights and sounds of flowing water, still water, the bracing effects of the “thunder” of falling water, the sight of waterfalls).

Information for cognitive development

Natural watercourses provide fluid landscapes for scientific and field studies in such areas as hydrology, ecology, geography and cultural anthropology.

Mangrove (PIC: Karen Lee)

It was estimated that the total area of mangroves in Hong Kong as 456.8 ha (0.41% of the total habitats mapped in 2008, Susdev 2008). There are about 60 mangrove stands being recorded in about 170 locations around Hong Kong, and mainly distributed along the coastal area and estuary in Sai Kung, Northeast New Territories, Tolo Harbour, Deep Bay and Lantau Island (AFCD 2013a; CAHK 2013). There are eight mangrove species being recorded in Hong Kong: *Kandelia obovata*, *Avicennia marina*, *Aegiceras corniculatum*, *Acrostichum aureum*, *Excoecaria agallocha*, *Heritiera littoralis*, *Bruguiera gymnorhiza*, and *Lumnitzera racemosa* (AFCD 2013a). Among the eight mangrove species, the most common and abundant mangrove species in Hong Kong are *K. obovata* and *A. corniculatum* (Tam and Wong 2000).

Food provision

Mangrove forests provide abundant food resources to wildlife and indirectly to humans. The mangroves supply forestry products including timber and firewood and fishery products, such as crabs and fish (Kathiresan 2012). Fallen leaves of mangroves are important food for crustaceans which associated with mangroves. These leaves also serve as vital links in

the wetland good web (AFCD 2013a). Further, some crustaceans, such as marine shrimps (*Penaeus* sp. and *Metapaneus* sp.) spend parts their life cycles, or the entire ones, with the mangroves. Some bird species, mainly waterfowls, feed on aquatic organisms including shrimps and crabs associated with mangroves (CAHK 2013). Besides, the orange flowers of *A. marina* can be used for producing honey (AFCD 2013a). However, the amount and cost of food produced by mangroves has yet quantified.

Air quality

Mangrove forests help reducing air pollutants and removing air pollutant deposit in the sediment via run-off (Tam 2006). Further, mangroves can assist in filtering and maintaining water and air quality by sequestering carbon dioxide and helping the sediments to retain gases and heavy metals.

Moderation of extreme events

Mangroves can stabilise water capacity of the substratum and on the soil surface, hence steady and retain water to prevent flooding. In recent years, the low-lying areas in New Territories have been affected by floods during thunderstorms. It is largely because the development projects have changed the land use of wetlands (CAHK 2013).

Water flows

Mangroves improve water quality and clarity by filtering upland runoff and trapping waterborne sediments and debris. However, the rapid mangrove expansion may have adverse consequences on the drainage capacity and increasing the flooding risk in parts of the New Territories (Chan et al. 2011).

Waste treatment (water purification)

Mangroves serve as a water treatment system for the estuary. Mangroves help to remove or filter pollutants, such as heavy metals and total suspended solids (e.g. Wong et al. 1997; Tam 2006). Insects and microbes inhabit in mangroves and associated wetland help decomposing the organic matter (AFCD 2013a).

Erosion prevention

Mangroves protect our shorelines from erosion due to waves, and intense weather, such as storms and typhoons. The roots of mangroves also help maintaining shore stability, trap sediment to expand shore area.

Maintenance of soil fertility

Mangroves can improve soil fertility (Ren et al. 2009). Mangroves produce large amounts of litter in the form of falling

leaves, branches and other debris. Decomposition of the litter contributes to the production of dissolved organic matter and the recycling of nutrients both in the mangal and in adjacent habitats. The organic detritus and nutrients could potentially enrich the coastal sea and, ultimately, support fishery resources. The contribution of mangroves could be particularly important in clear tropical waters where nutrient concentrations are normally low (Kathiresan 2012). The nutrient contents of the mangrove species are different in the succession stage and the accumulated amount of elements in mangroves is closely correlated with the soil fertility (Bin et al. 2002).

Aesthetic value

A mangrove forest is a beautiful environment. It provides wildlife places for living and foraging, and gives human places for economic activities (like fishery and agriculture) or interactive classrooms for outdoor teaching. The rich ecology and unique scenery of mangroves serve as a sight-seeing route of ecotourism, leisure and recreational purposes (CAHK 2013).

Habitat services

Mangroves provide a diverse habitat, breeding and feeding grounds for numerous coastal and marine species. Mangroves and its associated habitats, such as intertidal mudflats, also provide important habitats, including nesting sites, for birds such as Ardeids (e.g. Li and Lee 1998). For example, according to the previous field surveys on the mudflats at Hang Hau Tsuen associated with mangroves (CEDD 2009), fauna abundance inside the mangroves were lower than that on the adjacent mudflats. Species recorded including Mangrove Gastropod (e.g. *Neritina violacea*, *Nerita chamaeleon* and *Littoraria ardouiniana*) and Mangrove Crabs (e.g. *Uca arcuata*).

Plantation or Plantation with Mixed Forest (PIC: S.T. Chiu)

Hong Kong's present-day vegetation is shaped by centuries of human deforestation in the past and by continued efforts of re-forestation and the influence of natural succession in the last 60 years. Tree planting on Hong Kong's barren hills was a major undertaking for the purposes of slope stabilization, enhancing water catchment and beautifying the degraded landscape. Both native pine and exotic species were used for establishing a tree cover on exposed sites and eroded soils. With time, the woody understorey of self-seeded native broadleaved species has regenerated into secondary mixed woodlands. Hence, this habitat description refers to lands covered in tree species varying from low saplings to mature trees and the vegetation community reflects the type of tree species originally used for tree planting.

Air quality

Forests create oxygen and take up carbon dioxide. Evapo-transpiration processes of forest maintain the vapour transformation process of the hydrological cycle and the amount of moisture in air.

Erosion prevention

With time, the original tree cover created by monospecific plantations has supported the establishment of a woody understorey of self-seeded native broadleaved species which has regenerated into secondary mixed woodlands with the passage of time.

The present day 'mosaic of habitat landscapes' prevents denudation or degradation of the land by overgrazing by feral cattle or disturbance by hill fires which in turn maintains the health of the steep hilly landscape especially the integrity of the hydrological features and prevention of soil erosion. The areas where a dense broad-leaved tree forests has re-established are perfect fire breaks to halt spreading hill fires and, thus, intercept cascades of water and sliding mud in the event of landslides on the mountain slopes caused by subsequent torrential summer rains and typhoons in areas that might be made bare by hill fires.

Maintenance of soil fertility

The restoration of forests can bring beneficial changes to a soil generally poor in nutrients. A tree cover changes the microclimate to provide cool shade to the ground lowering the local ground temperature within the forests and creating the accumulation of leaf litter on the forest floor. A forest cover ameliorates soil conditions such as soil moisture, pH and micro-nutrients and contributes to the development of the soil micro-flora and litter community. In areas where leguminous species were originally used for afforestation, these had a role in replenishing soil nitrogen levels.

Fung Shui Forest (PIC: Gunter Fischer)

These forests account for only 0.2% of all habitats in Hong Kong. These woodlands are generally small in area but have been a feature of the landscape for centuries. They include some of the oldest forest patches in existence in the territory – the forest at Shing Mun Tai Wai, for example, is thought to be over 400 years old. Fung Shui forests are either preserved or planted for reasons of “fung shui” to maintain the most favorable location for buildings and settlements within a village or a temple (i.e. as sacred or lucky groves). While they are situated close to areas with high human impact, including villages, temples, in ravines and near water, these patches contain a range of different assemblages of ornamental and economic species, as well as native shade-tolerant species. Inside the forests, we can find climax tree species such as *Endospermum chinensis*, *Pygeum topengii* and *Cryptocarya* ssp. alongside trees of economic value, such as *Aquilaria sinensis*, *Cinnamomum camphora* and various fruit trees.

Water, water flows and erosion control

Forests play a crucial role in the natural water cycle. The vegetation takes up rainfall, filters and slowly releases it as clean drinking water all year round. The evapotranspiration of forests enhances cloud formation and rainfall. Healthy forests act as a sponge, taking up excess water, which prevents high run offs, soil erosion and landslides protecting streams, rivers and the sea from sedimentation. Once the native forest has been destroyed or replaced by non-native tree species these services can't be guaranteed.

Genetic and medical resources

The more mature the forest the higher the species diversity and the genetic diversity. A high genetic diversity is essential to guarantee a healthy forest in the long run, since species are more resilient to environmental changes. A high genetic diversity is also essential for humans since different genotypes are needed for plant breeding, and other applications in particular in times of climate change, where it will become important to develop new varieties of crops adapted to new climatic conditions such as more rainfall or increased drought. A diverse forest is also an invaluable resource for medicine and other non-timber forest products.

Air quality

Forests sequester carbon dioxide thereby reducing greenhouse gases in the atmosphere and fighting climate change. Fine particles, dust and air borne pollutants are filtered and bound by dense forest vegetation. Trees produce oxygen essential for human survival.

Maintenance of soil fertility

The natural nutrient cycle in the forest maintains the soil fertility. Once the vegetation is removed rain, washes out the nutrients and the soil constantly loses its fertility.

Cultural and amenity services

Forests have a high recreational value, in particular in overcrowded Hong Kong the provision of natural areas is essential for human well-being. Forests are an inspiration for culture, art and design and provide spiritual experience through offering calm and peaceful places in nature.

Montane Forest (PIC: Gunter Fischer)

In Hong Kong we can distinguish between a lower montane (400-800 m altitude) and an upper montane subtropical forest (above 800 m altitude). Similar to the tropical lowland forest no primary forest has survived human disturbance over the centuries. Only in remote and highly inaccessible ravines and steep slopes, protected from frequent hillside fires and

logging, very small fragments of mature forest survived. These relict forests are the main seed source for the different successional stages of the recovering surrounding secondary vegetation. The more mature secondary forest stands can be very rich in species and of high ecological value. The canopy is dominated by subtropical species of the families *Fagaceae*, *Lauraceae*, *Theaceae*, *Magnoliaceae*, *Rutaceae* and *Hamamelidaceae*. On mountaintops more cold tolerant families such as *Aceraceae*, *Oleaceae* and *Gymnosperms* emerge.

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Seagrass Bed (PIC: Karen Lee)

Seagrasses mainly grow in mud or sand. The seagrass bed accounted for 6.6 ha (0.01% of the total habitats mapped in 2008 (Susdev 2008). Seagrass meadows generally occur in shallow, sheltered, soft-bottomed marine coastlines and estuaries (Fong 1998). Several small patches of the Seagrass (*Halophila beccarii* and *H. ovata*) occurred on the intertidal shore along the outer edge of the mangrove belt in the northern New Territories, nearby Hai Pak Nai (Tam and Wong, 1997), forming a low mat of vegetation on slightly raised mounds of sandy sediment. It has been suggested that the Spoon Grass (*H. beccarii*) has extended its range on the intertidal mudflat along the southern fringe of Deep Bay, from Sha Kiu Tsuen to Ha Pak Nai (Fong 1998).

Erosion prevention

Seagrasses help to reduce erosion and improve water quality. The leaves and upright stems of seagrasses serve as baffles, reducing water speed near the sediment surface. Thus, allows suspended particles in the water to deposit to the bottom and improve water quality. Further, the rhizomes and rootlets of the seagrasses help to bind the sediment particles, which provide protection against wave-induced erosion and hence, protect the shorelines. The epiphytes which grow on the fronds of seagrass also help filtering the water and hence, improve the water quality (Stewart and Fairfull 2007). Further, it is suggested that the presence of low-biomass seagrass bed can maintain a higher bed level, offsetting wave strength before reaching the beach and hence, lowering beach erosion rates (Christianen et al. 2013). However, the *H. ovata* is a short-lived annual plant and has wide distribution which can colonize some areas in a short time but disappears quickly under unfavourable conditions, e.g., typhoon or strong water current (Fong 1998).

Habitat services

Seagrasses provide habitat for juvenile and adult fish, and other aquatic organisms. Many commercially and recreationally important fish species spend the entire or part of their life cycle in seagrass bed, including snappers. Further, seagrass beds are also used by fish as spawning ground and refuge against predators (Stewart and Fairfull 2007).

Rocky Shore (PIC: Kevin Kwok)

Recent consultant work for the Hong Kong government defines rocky shores as “areas of stable (non-mobile) rocks larger than cobbles between the high and low tide marks, covering more than 50% of the area” (Susdev 2008). Total area of these shores was found increased significantly from 91 ha to 1424 ha between 2007 and 2008 and the change was due to

change in survey methodology (Susdev 2008). They are classified as medium value ecological habitat.

Food provision

Macroalgae and mollusks from rocky shore are collected sparsely as food. Food organisms include macroalgae *Ulva* species and gastropod *Cellana* species.

Recreation and tourism

Shore fishing is a popular sport with in Hong Kong. The exact number of recreational fisher is unknown, but WWF estimates the number to be around 500,000 (Legislative Council Paper No. CB(2)828/11-12(02)). A large proportion of fishers practice rock fishing, i.e. fishing at rocky shores. Many fishers also use rocky shore mollusks as baits for fish.

Education value

Secondary school and university students go to rocky shores for field trip to learn about Hong Kong's natural heritage and to learn ecology and biology.

Raw materials and genetic resources

Rocky shore provides environment and biological resources for research. Besides basic research regarding biology and ecology of rocky shore species, more applied research using biomolecules and genetic materials of the rocky shore species are common. More well-known examples including bioadhesive from barnacles, byssus from mussels for garments and other purposes, novel chemical compounds from rocky shore microbes for making anti-fouling compounds, to using rocky shore species like copepod *Tigriopus* species as live food for fish larvae in aquaculture.

Barrier of disturbance

Rocky shores are natural transition between marine and terrestrial environment. It also act as a buffer zone to limit influence of the terrestrial environment to the marine one, vice versa. For example, Rocky shores, especially more sheltered ones, tend to trap terrestrial soil and materials from the sea; it also shield terrestrial environment from wave splash.

Sandy Shore (PIC: Karen Lee)

Sandy shores are gentle sloping coastal soft shores with unstable substrata. The total area of sandy shore estimated in Hong Kong was 211 ha (0.19% of the total habitats mapped in 2008 (Susdev 2008)). In general, sandy shores in Hong Kong are classified into two groups: exposed and sheltered/ enclosed sandy shores, depending on the extent of wave action.

Further, pattern of vertical and horizontal distributions of organisms can be found in and on the shores (Chan and Caley 2003).

Food provision

Sea urchins (e.g. *Salmacis sphaeroides*), sea cucumbers (e.g. *Holothuria sp.*) and bivalves (e.g. *Tapes variegatus*) are commonly found in shallow waters with sandy substratum in Hong Kong (AFCD 2013d). Further, some people dig for clams in summer (refer to intertidal mudflats section) for commercial and recreational purposes.

Moderation of extreme events

The accumulation of sediment particles on sandy shores is mainly deposited by waves with the grain size 50-2000 μm (0.05-2 mm). The beaches also receive particles from marine biogenic sources, such as shell fragments and sponge spicules (Brown and McLachlan 2002). The sandy shores serve as a buffer zone or shock absorbers to protect the coastline from direct wave attack.

Aesthetic value

The appreciation of beaches and dunes make sandy coasts an attractive living environment. Beaches also provide important coastal recreational areas for people, such as surfing.

Habitat services

Some species use the sandy shore as a spawning ground. In Hong Kong, the green turtles (*Chelonia mydas*) return to Sham Wan on Lamma Island every year to lay eggs. Further, juvenile Horseshoe Crabs (e.g. *Tachypleus tridentatus*) also utilized the sandy shore to spawn (AFCD 2013c).

Coastal Water (PIC: Kevin Kwok)

According to the Land Department, Hong Kong has a total marine area of 1650 km^2 . Most, if not all, of the area can be classified as coastal waters.

Food Provision

Until recently, fishing activities in HK coastal waters is frequent and provided HK people with a staple protein source. As pointed out by the report of the Committee on Sustainable Fisheries (CSF WP 1/10), the production of Hong Kong capture fishing fleet was around 158,000 tonnes, with a value of HK\$1.78 billion in 2008. It is estimated that around 26% of the production (around 37,700 tonnes) came from Hong Kong waters, with the rest mainly from the South China Sea. The

supply from the Hong Kong fishing fleet accounted for around 5% of all marine fisheries products consumed in Hong Kong. No data of fishing catch are available after the trawling ban in 2010.

Mariculture is also an important activity in Hong Kong waters. Currently there are 26 fish culture zones occupying 209ha with 1008 licensed operators (AFCD webpage). Practitioners typically grow fish in floating rafts in sheltered inshore areas. . Common species under culture include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, goldlined seabream, star snapper and red drum. The estimated production in 2012 was about 1,299 tonnes valued at \$117 million which catered about 8 per cent of local demand for live marine fish. 12 fish culture zones also allow recreational fishing on the mariculture rafts (AFCD webpage). There are also some oyster farming adopted the raft culture method, i.e. oysters placed in baskets suspended from rafts.

Cultural and amenity services

Boating, sailing and various other water sports are very popular among HK people. Hong Kong's first Olympic gold medal was for windsurfing, a water sport, by Lee Lai Shan. Scuba diving is also an increasingly popular activity in locally.

Aesthetic

In Hong Kong, flats with sea view are generally more preferred and can be sold at a higher price.

Habitat service

The local waters are under the influence of various ocean currents (Kuroshio, Taiwan and Hainan currents) and allow exchange of genetic materials in different populations of marine organisms (Morton and Morton 1982). It is also an important habitat for many species.

The southern water of Hong Kong is home to protected species Finless Porpoise.

Recreation and Tourism

The Victoria Harbour is an important icon of Hong Kong. The Hong Kong Tourism Association has a junk boat taking tourists for tour along the Victoria Harbour every night. There are also local ferry tours around the harbour.

Chinese white dolphin is a protected species inhabiting western waters of Hong Kong. It is a charismatic species that Hong Kong people have great affection for. Local boat tours for watching Chinese white dolphin is popular.

Coral Areas (PIC: Allen To)

There is no comprehensive study on the total sea area cover with corals. However at least 33 locations in Hong Kong has at least 20 – 78.1% of coral coverage (based on a 100 m-transect survey at each designated location) (AFCD 2013a). In three locations where “marker buoys” were installed since 2002 for coral protection (including Ung Kong Wan, Port Island and Sharp Island), there has been an overall improvement in cover coverage (AFCD 2013a). There are eight sites chosen in accordance with the annual Reef Check in Hong Kong, using the Coral Health Monitoring Chart, to monitor health of corals. Results showed that the corals in those locations were in healthy and stable conditions (AFCD 2013a). Despite this, a comprehensive review reported that coral areas in Hong Kong are most at risk from overfishing and destructive fishing activities (Ang et al., 2004).

Food provision

One of the major ecosystem services of corals in Hong Kong is the provision of food-fisheries. Local coral areas are important spawning and nursery grounds for numerous commercially significant fishery resources (AFCD 2013b). Coral areas are also fishing grounds for local fisheries. For instance high commercial value species such as groupers, parrotfishes, sea breams, snappers, sweetlips, wrasses (Sadovy and Cornish, 2000; Situ and Sadovy 2004; To and Sadovy de Mitcheson 2009) and sea urchins (Ang et al. 2004). Further, the commercial fisheries also include relatively lower-value species such as damselfishes and cardinalfishes (Situ and Sadovy 2004; Ang et al. 2004). Such kinds of fish are mostly harvested for food trade locally. In 2012, the overall capture fisheries in Hong Kong (including those harvested outside Hong Kong waters) were about 155 thousand tonnes. It was reported that around 10% of the catches of commercial fisheries in Hong Kong are from waters within Hong Kong (Ang et al. 2004). There is no catch data for coral areas, but there's data in general for coastal fisheries in Hong Kong.

Recreational fishing activities do exist in Hong Kong. In 2002, it was estimated that there were about 500,000 recreational fishers in Hong Kong, and was ranked number 8 in terms of popularity among all sports activities in Hong Kong, and the total recreational fisheries was valued at HK\$900 million (AFCD 2004). However it is unknown regarding the proportion of this value generated from such activities conducted in coral areas.

Extreme weather moderation

Large coral reefs overseas are reported to be fundamental in reducing the impact of natural disasters on the shore line and people inhabit that area such as tsunami (Kunkel et al. 2006; Fernando et al. 2011). In Hong Kong, corals are suggested to offer protection to the coastline and stabilize the substrata from water wave action and storms. Thus, are extremely important to water and soil protection of the coast (AFCD 2013b).

Aesthetic value

Coral areas in Hong Kong have high aesthetic value and can attract lots of snorkelers and scuba divers, both national and international (AFCD 2013b). It was reported that more than 30,000 divers were certified in Hong Kong in past 10 years (Chung et al. 2014). However, the economic value of diving in coral areas has not been thoroughly reviewed for Hong Kong.

Habitat services

Coral areas in Hong Kong support a huge diversity of marine species. In Hong Kong, there are 84 stony coral species documented, which form the basis of coral areas. A variety of marine organisms, such as 77 species of crustaceans (77 species), 55 species of molluscs, 95 species of echinoderms and 500 species of fish are associated with the corals in Hong Kong (Ang et al. 2004).

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Appendix III: Scoring of ecosystem services in each habitat in Hong Kong

	Grassland / Shrubby Grassland	Lowland Forest	Mixed Shrubland	Cultivation (abandoned)	Modified Watercourse	Fishpond / Gei Wai
Provisioning services						
food	1	1	1	3	1	3
water	3	3	3	3	3	1
raw materials	1	1	1	1	1	1
genetic resources	1	1	1	1	1	1
medical resources	1	1	1	1	1	1
ornamental resources	1	1	1	3	1	1
Regulating services						
air quality	1	3	3	2	1	1
climate	1	1	1	1	1	1
moderation of extreme events	1	1	1	2	1	3
water flows	3	3	3	3	3	1
waste treatment (water purification)	3	3	3	1	1	1
erosion prevention	3	3	3	1	1	1
maintenance of soil fertility	3	3	3	1	1	1
pollination	1	3	3	3	1	1
biological control	1	3	3	1	1	1
Cultural and amenity services						
aesthetic	3	3	2	2	3	3
recreation and tourism	3	3	2	3	3	3
inspiration for culture, art and design	2	3	2	3	3	3
spiritual experience	2	3	2	3	3	3
information for cognitive development	2	2	2	3	3	3
Habitat services						
maintenance of life-cycle of migratory species	3	3	3	3	1	3
maintenance of genetic diversity	2	3	3	3	1	3

1 = not significant or not relevant

2 = moderately significant

3 = very significant

	Intertidal Mudflat	Bare Rock or Soil	Freshwater / Brackish Wetland	Natural Watercourse	Mangrove	Plantation or Plantation / Mixed Forest
Provisioning services						
food	2	1	2	2	2	1
water	1	1	2	3	1	2
raw materials	1	1	1	1	1	1
genetic resources	1	1	1	1	1	1
medical resources	1	1	1	1	1	1
ornamental resources	1	1	1	1	1	1
Regulating services						
air quality	1	1	1	1	3	3
climate	1	1	1	1	1	1
moderation of extreme events	3	1	2	2	3	2
water flows	3	1	3	3	3	2
waste treatment (water purification)	1	1	3	3	3	2
erosion prevention	3	1	3	1	3	3
maintenance of soil fertility	1	1	3	2	3	3
pollination	1	1	2	1	3	2
biological control	1	1	1	2	3	2
Cultural and amenity services						
aesthetic	3	2	3	3	3	2
recreation and tourism	3	3	3	3	3	2
inspiration for culture, art and design	3	2	3	3	3	2
spiritual experience	3	3	3	3	3	2
information for cognitive development	3	3	3	3	3	2
Habitat services						
maintenance of life-cycle of migratory species	3	1	3	3	3	1
maintenance of genetic diversity	3	1	3	3	3	2

	Fung Shui Forest	Montane Forest	Seagrass Bed	Rocky Shore	Sandy Shore	Coastal Water	Coral Areas
Provisioning services							
food	2	1	1	2	3	3	3
water	2	3	1	1	1	1	1
raw materials	1	1	1	2	1	1	1
genetic resources	1	1	1	1	1	1	1
medical resources	1	1	1	1	1	1	1
ornamental resources	1	1	1	1	1	1	1
Regulating services							
air quality	2	3	1	1	1	1	1
climate	1	1	1	1	1	1	1
moderation of extreme events	2	2	1	2	3	3	3
water flows	2	2	1	1	1	1	1
waste treatment (water purification)	2	2	1	1	1	3	1
erosion prevention	2	3	2	1	1	1	1
maintenance of soil fertility	2	3	1	1	1	1	1
pollination	3	3	1	1	1	1	1
biological control	3	3	1	1	1	1	1
Cultural and amenity services							
aesthetic	3	3	3	3	3	3	3
recreation and tourism	3	3	2	3	3	3	3
inspiration for culture, art and design	3	3	2	3	3	3	3
spiritual experience	3	3	2	3	3	3	3
information for cognitive development	3	3	3	3	3	3	3
Habitat services							
maintenance of life-cycle of migratory species	3	3	2	1	2	3	2
maintenance of genetic diversity	3	3	3	2	2	3	3